

THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC

AND

Photographer's Daily Companion

WITH WHICH IS INCORPORATED

'THE YEAR BOOK OF PHOTOGRAPHY AND AMATEURS' GUIDE'

AND "THE PHOTOGRAPHIC ANNUAL"

1917

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CLASSIFIED INDEX TO GOODS ADVERTISED
INDEX TO ADVERTISERS

AT END
VOLUME

PREFACE

Photographic.

The present ^{14th} edition, issued since the outbreak of the European War, in 1914, to reflect seriously by its reduced size the circumstances of the times. The lesser bulk of both text and advertisements has been dictated by the restriction in the supply—and the very greatly increased cost—of paper. No doubt some advertisers would have made their announcements on a larger scale had not the publishers of the Almanac limited advertisements to sixteen pages, and thus very properly checked possible disparities.

The paper question is likewise chiefly responsible for the reduction this year of the edition of the Almanac from 30,000 to 20,000 copies. It is to be feared that this number will not satisfy the demand, but we are sure that the photographic public will accept our assurance that retrenchment was a commercial necessity, and that our publishers have taken the course judged to occasion the least inconvenience to buyers of the Almanac.

The above is by no means a complete recital of the special conditions experienced in producing the 1917 Almanac. Others will probably delay publication beyond the promised date of January 31. Again, in times of "nothing-as-usual," we would claim the indulgence of our readers, in the hope and belief that before another Almanac is ready Europe will have witnessed the defeat of the Prussian military caste,

GEORGE H. BROWN,

Editor.

24, Wellington Street,
Strand, London.

December 4, 1916.

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- "Journ. S. C. I." "Journal of the Society of Chemical Industry."
Vacher & Sons, Ltd., Westminster House
Great Smith Street, London, S.W.
- "Journ. Soc. Arts" .. "Journal of the Royal Society of Arts."
G. Bell & Sons, Ltd., York House, Portugal
Street, London, W.O.
- "Knowledge" "Knowledge."*
Knowledge Publishing Co., Ltd., 42, Blooms-
bury Square, London, W.O.
- "Le Phot." "Le Photo Journal."
22, Rue Vurenn, Paris.
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17, Rue des Moines, Paris, France.
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- "Oest. Phot. Zeit." .. "Oesterreichische Photographen Zeitung."
Oesterreicher Photographen-Verein, Vienna
III/I.
- "Opt." "The Optician."
Gutenberg Press, Ltd., 123, 124 & 125, Fleet
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- "P.M." "The Photo-Miniature."
103, Park Avenue, New York, U.S.A.
- "Pharm. Journ." .. "The Pharmaceutical Journal."
72, Great Russell Street, London, W.O.
- "Phil. Mag." "The Philosophical Magazine."
Taylor & Francis, 7 $\frac{1}{2}$, Red Lion Court, Fleet
Street, London, E.C.
- "Phil. Trans." .. "Philosophical Transactions of the Royal
Society."
Harrison & Sons, 45, St. Martin's Lane, London,
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- "Phot." "Photography and Focus."
Hiffe & Sons, Ltd., 20, Tudor Street, London,
E.C.
- "Phot. Chron." .. "Photographische Chronik."
W. Knapp, Halle a/Saale, Germany.
- "Phot. Couleurs" .. "La Photographie des Couleurs."
118, Rue d'Assas, Paris.
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31, Blücherstr., Berlin S 61, Germany.
- "Phot. Journ." .. "Journal of the Royal Photographic Society
of Great Britain" ("The Photo-
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Harrison & Sons, 45, Pall Mall, London, S.W.
- "Phot. Korr." .. "Photographische Korrespondenz."
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Paul Heysestrasse 29/31, Munich, Germany.

INTERNATIONAL PHOTOGRAPHIC ALMANAC, 1917	
"Phot. Journ. America."	"Photographic Journal of America." (formerly "Wilson's Photographic Magazine") 122, East 25th Street, New York, U.S.A.
"Phot. Rund."	"Photographische Rundschau" 19, Mühlweg, Halle a/S, Germany.
"Phot. Scraps"	"Photographic Scraps." (discontinued January 1915)
"Phot. Times"	"The Photographic Times." 13, West Fourteenth Street, New York, U.S.A.
"Phot. Welt"	"Photographische Welt." (M. Eger), 4, Gabelbergerstrasse, Leipzig, Germany.
"Phot. Woche"	"Photographisches Wochenblatt." 131, Genthiner Strasse, Berlin, W.
"Photo-Era"	"Photo Era" 323, Boylston Street, Boston, Mass., U.S.A.
"Photo Gazette"	"Le Photo Gazette" 1, Rue de Médecin, Paris, France.
"Photo-Revue"	"Photo Revue" 118, Rue d'Assas, Paris VI, France.
"Photo-Woche"	"Photo-Woche" 6, Lietzenau Ufer, Charlottenburg, Berlin.
"Photographie"	"La Photographie" 118, Rue d'Assas, Paris, France.
"Phys. Rev." ..	"The Physical Review" 41, North Queen Street, Lancaster, Pa., U.S.A.
"Procédé" ..	"Le Procédé." 150, Boulevard de Montparnasse, Paris XIV.
"Rev. Trimest"	"Revue des Travaux de Recherches." A Lumière et ses Fils, Lyons.
"Sci. Amer." ..	"The Scientific American." Munn & Co., Inc., 361, Broadway, New York, U.S.A.
"Sonne" ..	"Sonne" Kaiser Platz, 18, Wilmersdorf, Berlin.
"Wiener F. Phot. Zeit"	"Wiener Freie Photographen Zeitung" Gustav Walter, Alserstrasse 71, Vienna VIII, Austria
"Wien. Mitt." ..	"Wiener Mitteilungen." Graben 31, Vienna I, Austria.
"Wilson's" ..	"Wilson's Photographic Magazine," now "Photographic Journal of America." 122, East 25th Street, New York, U.S.A.
"Zeit. für Instr."	"Zeitschrift für Instrumentenkunde." Julius Springer, Berlin.
"Zeit. für Repro."	"Zeitschrift für Reproduktion." W. Knapp, Halle a/Saale, Germany.
"Zeit. für Wiss. Phot."	"Zeitschrift für Wissenschaftliche Photographie." J. A. Barth, 16, Doberplatz, Leipzig, Ger- many.

CHEMICAL NOTIONS FOR PHOTOGRAPHERS.

BY THE EDITOR.

The present times are not appropriate to the selection for the editorial article in this "Almanac" upon a subject dealing with outdoor photography. Indeed, it is difficult to choose from the various branches of photographic work any one which calls particularly for the kind of literary treatment which one seeks to accord to it in this place. In no case, as is natural from the circumstances of the time, can we point to any particularly notable progress. We must wait for the days of peace before we can expect, either from individual workers or from photographic manufacturers, advances and investigations which will put a new complexion upon one or other of the branches of photography, or, by some striking discovery, will impart a fresh impetus to photography as a whole.

In these circumstances it is especially fitting that one should take the occasion of seeking to interest the photographic worker in the chemical side of the processes which he carries out. There is undoubtedly need for such an effort. It is a constant complaint of the scientific men in this country that in addressing themselves to the general public they are unable to assume even a nodding acquaintance with the elements of physical sciences such as those which deal with light, sound, electricity, or chemistry. We learn something of these things at school, and speedily forget all about them. It is quite true that, nationally, we require stirring up to perceive the vital connection between the operations of physical and chemical laws and our industrial and national prosperity. This is a great question, now occupying the minds of our leaders of education: photography is only a small and perhaps a despised branch of industry or handicraft. Nevertheless, it is quite worth while doing something towards enlisting the interests of

those more or less closely connected with photography in an amateur or in a commercial way in the elementary principles of one of the two branches of knowledge with which photography has naturally much to do. The properties of light in forming images by the aid of lenses and the optical facts which bear upon the proper use of photographic lenses have been constantly brought before photographers, but the elementary chemical notions with which all photographic work subsequent to the exposure of the plate is intimately connected have been far less in prominence.

I would make it clear at the outset that the aim of this article is not to deal with the chemistry of photography: it is not to discuss the chemical changes which go on when a plate is exposed to light or when a print by one or other of the various processes is produced. The aim is to present in as simple a manner as possible some of the fundamental conceptions which are the current stock-in-trade of chemists, but which unfortunately are so completely foreign to the majority of photographic workers that the occurrence of chemical symbols or formulæ in a society paper or in an article in a photographic journal is sufficient inducement to disregard it as being so "scientific" that it is necessarily incomprehensible. Well, we will try to see if something cannot be done to overcome that aversion. In doing it we will try to choose examples from operations familiar to photographers in the hope that they will thereby be encouraged to study the pages which follow, and thereby to obtain from them a knowledge of the things done daily in photographic work, which goes a little deeper below the surface than that which they previously had.

WHAT IS CHEMISTRY?

The domain of the chemist among investigators of other fields of knowledge is, in a word, to find out what everything is made of and to discover the laws by which the formation and behaviour of chemical compounds are governed. We have become so accustomed to take everything as we see it that we have largely lost the sense of the wonderful which characterises even the most common substances. Take, for example, a chemical which is so familiar to photographers as bichloride of mercury. You weigh out and perhaps powder the heavy crystals, which, on shaking up in cold water, sink in a second or two to the bottom of the bottle. But if you shake them long enough, or if you use hot water, the heavy crystals disappear, and however long you keep the solution they will not settle out. The heavy bichloride swims invisibly in the water. And

that is only half the story. The other half is that the white fibrous-looking crystals themselves consist of nothing else than the heavy liquid metal, mercury or quicksilver, and the yellow, irritant gas, chlorine. The chemical combination of the mercury and chlorine has resulted in a substance of entirely new and different properties. Just in the same way the combination of the two gases, hydrogen and oxygen, produces water. Such examples could be continued *ad infinitum*. It is sufficient to mention these two to show that chemistry is no dry-as-dust science, but a branch of knowledge which offers endless surprises to the student who is first taking it up.

CHEMICAL ELEMENTS AND CHEMICAL COMPOUNDS.

The ancients, who, as their writings show, were intensely interested in the different properties of various substances, had the most primitive explanations to give of them, attributing their differences to the possession in greater or less proportion of one or more separate spirits or essences. It is only within the past few hundred years, and largely through the labours of the alchemists of the Middle Ages in their endeavours to convert base metals into gold, that a knowledge of the composition of the many mineral and organic substances has been obtained. The foundation of all this knowledge has been experiment, analysing substances—that is, splitting them up into their constituents largely through the agency of heat. Perhaps the classical example of this process is the discovery of the gas oxygen by the Birmingham divine, Priestly, towards the end of the eighteenth century. Priestly placed in one limb of a bent glass tube some oxide of mercury, and, applying heat with a burning-glass, found that he obtained from it globules of mercury or quicksilver and a gas which differed from ordinary air in the respect that anything which burnt in air would burn with much greater intensity in it. It was possible to show that the oxide of mercury could be entirely decomposed or analysed into these two constituents. This same process of analysis, applied through centuries by hundreds of investigators employing more refined methods as time went on, has at last shown that all the materials known to us—mineral, gaseous, animal, or vegetable—consist of only some seventy different substances. Many of these seventy are of rare occurrence. The greater part of the earth, so far as we know it, and of all upon it, consists of a comparatively few of these seventy substances. Also, so far as can be judged, they are the chief components of stars and planets. The chemist calls them elements only, because so far they have resisted all attempts to dissociate them into anything different from themselves. But with a knowledge of the views held in the past, the chemist regards these ele-

ments as really elementary only provisionally. Many substances now known to be composite (chemical compounds) were formerly thought to be elements, and it is, in fact, a conception—though only a conception—of the modern chemist that all these seventy so-called elements are themselves compounds, and have in the remote past originated from one simple form of material under conditions which it has been impossible to reproduce. That idea, however, would lead us too far from our present subject, and has, in fact, no direct bearing upon it. The chief elements which, in the form of chemical compounds, are of importance in photographic processes are given in the next paragraph.

SYMBOLS FOR ELEMENTS.

In writing down the names of these elements which, in various forms of chemical combination, give rise to the substances of which use is made in photography—and, for the matter of that, in most other branches of chemical manufacture—it will be well to append to each the contraction which chemists almost uniformly in all countries employ—a species of shorthand which serves for the convenient writing of chemical formulæ, but which, as we shall see directly, means a great deal more than this:—

Hydrogen (H.)	Sodium (Na.)
Oxygen (O.)	Potassium (K.)
Nitrogen (N.)	Magnesium (Mg)
Carbon (C.)	Silver (Ag.)
Sulphur (S.)	Mercury (Hg.)
Chlorine (Cl.)	Iron (Fe.)
Bromine (Br.)	Chromium (Cr.)
Iodine (I.)	Gold (Au.)
Aluminium (Al.)	Platinum (Pt.)

ATOMS AND MOLECULES.

The chemist's interpretation of experiments, chiefly upon gases, is that the atoms of the elements themselves combine together to form molecules. It would take us too far from our path to enter upon the considerations on which this fact—for it is more than a conception—has been established. Briefly it may be pointed out that if a mixture of one volume of oxygen and two volumes of hydrogen is ignited by an electric spark so as to cause the two gases to combine, and if the experiment be conducted so that the water which is formed is kept in the state of gas (steam), then it is found that the volume of steam is not three volumes but only two. It is clear from this that the atoms of oxygen have distributed them-

selves among twice the number of water molecules, and thus it is concluded that the oxygen exists as molecules consisting each of two atoms. By similar experiment and in accordance with a similar train of reasoning, it has been possible to show, in the case of elements which can be obtained in the form of gas, that their molecules consist of in most cases two atoms, in some other cases one atom only, and in others four or six. The elements which contain two atoms in the molecule are hydrogen, oxygen, nitrogen, chlorine, bromine, iodine, potassium, and sulphur. The metals mercury, zinc, and cadmium contain only one atom, whilst phosphorus has four in the molecule. We shall see the signification of these facts a little later on when dealing with the interaction of chemical compounds.

KINDS OF ELEMENTS.

The reader who has even the slightest acquaintance with chemistry will see at once that this list includes a number of familiar substances of widely different properties. Broadly, the chemical elements may be divided into two classes. The first, and by far the most numerous, class are the metals. Every metal, with the exception, of course, of mixtures of metals (alloys), is an element. The second and less numerous class includes the non-metallic elements, substances which are far more diverse in their properties than the metals. Among metals there is physically a certain family likeness among all of them. Generally speaking, they are all good conductors of heat and electricity, can be hammered or rolled into sheets to a greater or less extent, or can be drawn into wire. Chemically they have equally a family likeness in the fact that they all combine with greater or less readiness with oxygen to form oxides. The rusting or tarnishing of a metal in the air is a chemical change of this kind, a change to which practically every metal, with the exception of gold and platinum and other precious but rare metals, is liable. While metals all exhibit this property they differ greatly in the degree of avidity with which they combine with oxygen. The metal sodium, for example, instantaneously tarnishes in the air, and has such a chemical attraction for oxygen that if placed in water it combines with the oxygen and leaves the hydrogen to escape as bubbles of gas. Metals like iron, copper, and magnesium occupy a midway position in this respect, whilst at the other end of the scale are metals, such as silver, platinum, etc., which unite with oxygen, or elements like oxygen, only with the very greatest difficulty and require the use of indirect means in order to bring about the formation of such compounds.

Before leaving the metals it ought to be pointed out that chemically the gas hydrogen, the lightest element known, is a metal, existing now as a gas, so we may assume, only by the accident of circumstances just as iron which requires the most intense heat to render it fluid, exists as a gas in the atmosphere of the sun.

CHEMICAL COMPOUNDS.

The first notion which the student of chemistry requires to absorb is the essential and vital difference between a true chemical compound and a mechanical mixture of elements. The proportions in the two cases may be identical, but the compound is in no way comparable with the mixture. An experiment which anyone can try for himself will illustrate this point.

If we make a mixture of the finest iron filings and some sulphur (flowers of sulphur, as they are called by the druggist) as uniformly as possible, then the use of a magnifier will show that the grains of sulphur and the particles of iron are there side by side. If you go over the mixture with a magnet, you can pull out a large proportion of the iron dust. You may even separate the two more or less completely by shaking the mixture on a sheet of paper, the lighter sulphur being thrown off. Or you may stir the mixture in a solvent of sulphur, such as carbon bisulphide, which will leave the iron by itself as a deposit at the bottom of the vessel. But if you heat the mixture over a gas flame, in a small crucible, to quite a moderate degree, the iron and sulphur will combine with the development of heat. Once the action has started it will go on by itself, the mixture even bursting into small flames through some of the sulphur catching fire. When the action has died down, and the mass has become cold, you can reduce it to powder with a pestle and mortar, and then you will find that you have a substance out of which you cannot dissolve sulphur with carbon bisulphide, nor can you extract particles of iron from it with a magnet, although it contains both these elements. It may be, if the mixture has been made indiscriminately, that one or other of the constituents may be in excess because, as we shall learn directly, the chemical combination takes place only in certain definite proportions, and if more of one or the other of the inter-acting substances is in excess, it simply means that so much is left over in admixture with the compound which has been formed.

The operation which has just been described is a chemical reaction, one only of the many kinds of chemical change which gives rise to a new substance entirely distinct in properties from the materials forming the mixture. Some reactions take

place instantaneously; for example, the tarnishing of sodium or the action of sodium and water already referred to; others, like the rusting of iron, are slow. Some take place at the ordinary temperature; others require the application of heat to a greater or less degree to start them. But all these forms of reaction have a common feature in that they mark the formation of a chemical compound. The fact that about one-half of the weight of the earth's crust consists of the gas oxygen marks the intensity of the chemical combination which went on aeons ago in the process of the formation of the solid earth.

CHEMICAL COMPOUNDS OF DEFINITE COMPOSITION.

As we have learnt in the preceding paragraph, one mark of a chemical compound is that it differs sharply, often utterly, from a mixture which, as in the example just quoted, it may be possible to make of its constituents of the same composition. The next thing to remember about a chemical compound is that it necessarily has a definite composition. It is not a blend of the elements which compose it: it cannot be made to contain a little more of one element or a little less of another in the way that, for example, a paint may be made up with a little more pigment or a little less oil, or in which tea, tobacco, or whisky can be blended. On the contrary, a given chemical compound has a certain fixed composition, and if it be made by entirely different processes it nevertheless emerges at the end of this same composition. In other words, the "quality" of a chemical substance cannot be graded by small amounts as can that of the mixture. Its quality is a sharp property which, however, may be masked by a mixture, with the substance, of other bodies (impurities). It is the business of the chemical manufacturer to recognise these impurities and to get rid of them, but when we are speaking of pure chemical substances, then "quality" has no particular significance. If sulphite of soda is pure, we cannot talk of its being bad sulphite or good sulphite: it is simply sulphite of soda. And it follows from this that the minutest portion of any pure chemical compound is exactly the same as any other minute portion. As the late Sir William Ramsey has put it in one of his small text-books, "a mixture may be uniform throughout: a compound must be."

COMBINING PROPORTIONS.

Whence comes this constancy of the properties and composition of chemical compounds? It is that the elements combine together only in certain fixed proportions, and no art of man is able to cause them to combine otherwise. Chemists have learnt to visualise chemical combination as taking place between "atoms" of the elements—that is, between particles so small as to be incapable of further sub-division. From the results of

forming and analysing chemical compounds it has been possible to assign a number to each element representing the weight of its atom compared with that of a hydrogen atom, and thus representing the proportions in which the elements combine when they unite atom for atom, and equally of marking the combining proportions when combination takes place in any other ratio, such as one atom to two, two to one, two to three, three to two, and so on.

The starting point of finding these so-called "atomic" weights is the relative weight of oxygen which is required to combine with hydrogen to form water. By the most delicate experiments it has been found that 1 part by weight of hydrogen requires 6 parts of weight of oxygen when combination of the two takes place to form water. But other experiments show that in this process 2 atoms of hydrogen combine with 1 atom of oxygen. That is to say, the 8 parts of oxygen which combine with 1 part of hydrogen represents the weight of only "half an atom"—in other words, that the atomic weight of oxygen is 16. By similar means the atomic weight of almost every element has been determined with very great accuracy in the case of many.

ATOMIC WEIGHTS.

The atomic weights, in the case of the elements mentioned in a previous paragraph, are as follows:—

Oxygen, 16.	Sodium, 23.
Nitrogen, 14.	Potassium, 39.
Hydrogen, 1	Magnesium, 24.
Carbon, 12.	Silver, 108.
Sulphur, 32	Mercury, 200.
Chlorine, 35.5	Iron, 56.
Bromine, 80	Chromium, 52.
Iodine, 127.	Gold, 197.
Aluminium, 27.	Platinum, 193.4.

SYMBOLS MEAN RELATIVE WEIGHTS.

Now we can appreciate the fact, mentioned in a previous paragraph, that the abbreviated symbols used by chemists instead of the full names of the elements are more than convenient contractions; they represent the relative weights of the atoms of the elements in comparison with that of hydrogen. Thus, when a chemist writes a formula for, say, chalk—namely, CaCO_3 —that means not merely any chance conglomeration of the elements calcium, carbon, and oxygen, but a combination of these three elements in the definite proportions of their atomic weights or multiples thereof—namely, 40 parts of calcium to 12 of carbon and 48 (three times 16) of oxygen. It so happens that these several atomic weights add up to 100, and

thus by chance represent also the percentage composition of the substance. But the reader must keep clear in his mind the fact that these formulæ for chemical substances have been discovered in the first instance by analysing the bodies. The results of such analyses are usually expressed in percentages, and from these the formula can be calculated. Now that the chemical formulæ of the chief substances manufactured or found in a natural state are known, it is more often necessary to work out the percentage composition from the formula than to undertake the reverse calculation. But in present-day original investigation the discovery of the percentage composition of a new body is a preliminary to finding its formula.

But these atomic weights by themselves are not sufficient to tell us the proportions in which the elements combine together. Apart from their difference in atomic weight, there is another respect in which the elements differ—namely, in their combining capacities, atom for atom.

COMBINING CAPACITY.

Oxygen, for example, combines with hydrogen in the proportion of one atom of oxygen to two of hydrogen, but chlorine, in forming the substance hydrochloric acid, combines with hydrogen in the proportion of one atom of each. The atom of carbon, on the other hand, combines with four atoms of hydrogen, and that of sulphur with five atoms, or, strictly speaking, with this equivalent of other elements, since sulphur does not actually form a hydrogen compound of this type. This property of the various elements according to which they are able to combine with or saturate one or more atoms of hydrogen, or the equivalent in other elements, is termed "valency," and the elements of our list may be classified as follows in this respect:—

One atom Oxygen	combines with two atoms Hydrogen.
.. Nitrogen ...	.. 3 to 5 ..
.. Carbon .....	.. 4 ..
.. Sulphur .....	.. 2 to 6 ..
.. Chlorine ...	.. 1 ..
.. Bromine.....	.. 1 ..
.. Iodine.....	.. 1 ..
.. Aluminium..	.. 3 ..
.. Sodium .....	.. 1 ..
.. Potassium ...	.. 1 ..
.. Magnesium..	.. 2 ..
.. Silver .....	.. 1 ..
.. Mercury.....	.. 2 ..
.. Iron .....	.. 2 or 3 ..
.. Chromium...	.. 6 ..
.. Gold .....	.. 1 or 3 ..
.. Platinum ...	.. 2 or 4 ..

It will be noted from these figures that in the case of some elements the valency varies. Thus, that of sulphur is 2, 4, or 6, according to circumstances, and particularly according to the particular element with which it is combined. Sulphur will combine with only two atoms of hydrogen but with four atoms of chlorine and with three atoms of oxygen, equivalent to six of hydrogen. But it appears impossible to obtain compounds of sulphur and hydrogen in which four or six atoms of the latter are combined with one of the former. Perhaps we can get a better idea of the meaning of valency in chemistry by setting down a few compounds of elements in pairs among themselves. We will take only hydrogen, oxygen, carbon, chlorine, nitrogen, and mercury, and put down the symbols of the compounds which they form with hydrogen, chlorine, oxygen, and sulphur.

COMBINATIONS OF ELEMENTS.

		1. With Hydrogen.		2. With Chlorine.		3. With Oxygen.		4. With Sulphur.
H	.....	—	.....	HCl	.....	H ₂ O	.....	H ₂ S
O	.....	OH ₂	.....	—	.....	—	.....	O ₂ S (SO ₂)
C	.....	CH ₄	.....	CCl ₄	.....	CO ₂	.....	CS ₂
Cl	.....	ClH	.....	—	.....	—	.....	Cl ₂ S
N	.....	NH ₃	.....	—	.....	N ₂ O ₃	.....	—
K	.....	—	.....	KCl	.....	K ₂ O	.....	K ₂ S
Hg	.....	—	.....	HgCl ₂	.....	HgO	.....	HgS

On the left you will see the symbols of the five elements just mentioned with those of two others, potassium and mercury. The symbols on a line with each in columns 1 to 4 represent the compounds formed with hydrogen, chlorine, oxygen and sulphur. Hydrogen and chlorine being both "monovalent," that is, having a valency of 1, two atoms of either combine with one atom of oxygen (valency 2); four atoms combine with one of carbon (valency 4), and three atoms with one of nitrogen (valency 3).

Turning now to column 3, it will be seen that the compound of oxygen and carbon (CO₂) is formed in accordance with the respective valencies of the two elements—the carbon atom of valency 4 is saturated, so to speak, by two oxygen atoms each of valency 2. Similarly, two nitrogen atoms each of valency 3 are saturated by three oxygen atoms, each of valency 2.

Column 4 marks the variable valency of sulphur. In the compounds of hydrogen, the foul-smelling gas sulphuretted hydrogen, the valency of the sulphur is 2; in the compound with oxygen, SO₂, the gas, sulphur dioxide, the valency is 4, whilst there is also another sulphur compound with oxygen,

sulphuric anhydride, in which the valency of the sulphur is 6. In the combination of carbon and sulphur, carbon bisulphide, the valency of the sulphur is probably 2.

Although there are difficulties in deciding what is the valency of an element in certain compounds, yet, broadly, this characteristic of elements is a doctrine of the chemist which has proved its truth by enabling chemists to write down "out of their heads" the formulæ, that is to say, the chemical composition, of compounds which, at the time perhaps had never been prepared, but which subsequent experiment has enabled investigators to obtain. In the light of the doctrine of valency the chemist imagines the atoms of elements to exercise one, two, or more chemical attractions for other elements, and in compounds to be linked to each other by one, two, or more bonds. While, as I say, that is only a conception, yet it expresses one law according to which the elements combine together. For example, it having been established that the valency of carbon is 4, it is contrary to all chemical notions that a compound should exist having the formula CH_2 or CH , or any other formula for a compound of hydrogen and carbon which will not allow of the exercise of four units or bonds of valency on the part of the carbon atom. There are, it is true, certain compounds in which, apparently, all the units of valency of which an element is capable are not exercised, but the existence of such bodies is not a denial but rather a confirmation of the truth of the idea of valency, inasmuch as such bodies are always of what the chemist terms an "unsaturated" character, that is to say, they combine readily with other elements by the coming into play of the previously unexercised or unsaturated bonds.

GRAPHIC OR CONSTITUTIONAL FORMULÆ.

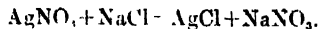
This conception of valency, that is to say, of the way in which the combining powers of the atom of an element vary and are exercised, has led chemists to the adoption of formulæ which seek to show more about a chemical substance than those in which only the symbols for the elements and number of each are written. For example, the chemical formula for water, H_2O , simply tells us that there are two atoms of hydrogen to one of oxygen, representing two parts by weight of the former to sixteen parts by weight of the latter. But the formula can be written to give a little more information than this, namely, as $\text{H}-\text{O}-\text{H}$. This, it will be seen, is in accordance with the valency (1) of hydrogen and of oxygen (2). It tells the chemist that the two hydrogen atoms are separately attached, and it suggests, what is a fact, that compounds can be formed in which one or both of the hydrogen atoms are replaced by some

other element. For example, if one only be replaced by the element potassium, we have the compound $K-O-H$, or caustic potash, and if both be replaced by potassium the compound $K-O-K$, or potassium oxide.

This development of representing the chemical behaviour of a compound by showing the linkage of the elements together, according to their units of valency, attains tremendous proportions in the case of compounds of carbon, a field of chemistry which has overwhelmed by its size and complexity that dealing with almost all the other elements put together. In many compounds of carbon it is quite possible to have precisely the same composition (the same number of elements combined together) but a different constitution. For example, the substance resorcin is identical in composition with hydroquinone, but, unlike hydroquinone, has not the slightest developing action on photographic plates. The difference which thus distinguishes the two compounds is one of constitution, and bodies which stand in this relation are said to be "isomeric" to each other.

It must not be supposed in all this that the lines used in these constitutional formulæ to indicate the distribution of the units of valency represent in any way the arrangement of the atoms in space with regard to each other. They are used only to present more graphically the mode of combination of the atoms among themselves as shown by their chemical behaviour.

In this graphic representation of the constitution of compounds chemists have developed a further and equally fruitful conception, namely, that of "radicles"—i.e., imaginary groups which in chemical reactions pass from one compound to another, but in most instances have no separate existence. A very simple example will better explain what is meant by a radicle. Every photographer probably knows that if you add a little solution of ordinary common salt (sodium chloride) to one of silver nitrate you throw down a white curdy precipitate of silver chloride. At the same time there is formed in the solution an equivalent quantity of sodium nitrate. The chemical "equation," as it is called, representing this change is as follows:—



This means that the chlorine of the salt has combined with the silver and that the sodium atom in each molecule of the sodium chloride has combined with the NO_3 of the silver nitrate. We call this latter a radicle, and it is only one of many which move from one compound to another in chemical changes, although they are, with very few exceptions, incapable of existence by

themselves. In the equation just written above the NO_3 is not the only radicle. The silver (Ag .) in the silver nitrate is also regarded as one: so also are the sodium (Na), and the chlorine (Cl) making up the sodium chloride. While these three latter components of the two compounds are elements, it is, nevertheless, unlikely that when uncombined they exist in the form of molecules composed of only one atom. It is known that in the case of chlorine the molecules consist of two atoms, and the chemist will thus write the formula for chlorine in its free state constitutionally thus: $\text{Cl}-\text{Cl}$, whilst the chlorine radicle is written $-\text{Cl}$. The sodium molecule and that of silver probably also have a similar constitution. This conception of radicles, as the *dramatis personæ*, so to speak, of chemical reactions, extends to all descriptions of compound, and radicles, like elements, are classed according to valency. In the example given above all four radicles, Ag ., NO_3 ., Na ., Cl ., have each a valency of 1. But other radicles such as SO_3 (that of sulphurous acid), SO_4 (that of sulphuric acid), CO , (that of carbonic acid), and C_2O_4 (that of oxalic acid), have a valency of 2. In the case of the metal radicles their valency is that of the elements themselves, as mentioned in a previous paragraph, although the student must not infer that metals, as they are known in their ordinary state, correspond in molecular character with these imaginary radicles. Probably many of the metals contain more than one atom in the molecule.

A little study of the component parts of chemical compounds in terms of these imaginary radicles will remove much of the difficulty which the would-be reader of papers, etc., containing chemical formulæ experiences in tracing the changes which are represented in the conventional shorthand of the chemist.

VARIOUS TYPES OF CHEMICAL COMPOUND.

Now we can come to a part of our subject which very likely the reader will consider less remote from practical facts than the foregoing "theoretical" considerations. Nevertheless, the former will be found necessary for a proper understanding of what follows. In chemical operations such as those chiefly concerned in photographic work, and, for the matter of that, also in any branch of chemistry dealing with the metals and their compounds, the three chief classes of substance are acids, bases, and salts. It is necessary to say a few words upon the chemical characteristics of each of these.

Acids.—All acids contain hydrogen, and most of them oxygen also. The name given to oxygen, and denoting "creator of acids;" is a misnomer, for it was not recognised at the time

that some acids, notably hydrochloric acid, contain no oxygen. For the most part acids are compounds of the non-metallic elements with hydrogen, and in by far the more numerous number of cases with oxygen also; but some few of the metals—for example, chromium—in combination with oxygen and hydrogen, form compounds of well-defined acid character. Thus the familiar substance potassium bichromate is a compound of bichromic or dichromic acid, and is definitely such even though the acid itself does not exist separately. Few of the acids formed from metals do, whereas on the other hand acids derived from elements of the non-metal class are well-defined substances existing separately; for example, sulphurous and sulphuric acid, formed from sulphur, nitric acid from nitrogen, phosphoric acid from phosphorus and hydrochloric acid (containing no oxygen) from chlorine.

Bases.—Chemically a base is something which “saturates” an acid, thereby causing the disappearance of the characteristic properties of both the acid and the base, and forming still another type of substance—a salt. Bases are oxides of metals or compounds closely resembling an oxide—namely, a hydroxide. This latter is a compound of oxygen, hydrogen, and a metal. It is, in fact, from the chemical standpoint, a derivative of water in which only one of the atoms of hydrogen has been replaced by a metal. Of substances in common use in photography which chemically are bases may be instanced sodium hydroxide (caustic soda), potassium hydroxide (caustic potash), and magnesium oxide (the white flakes which are produced when magnesium ribbon is burnt). Many of the substances, such as paramidophenol, used for developers, are likewise bases, and in a separate class by itself is that very important base ammonia. Ammonia gas, NH_3 , dissolves abundantly in water, forming a strong solution, the familiar liquor ammonia, which in many kinds of chemical reaction behaves like a solution of caustic soda or caustic potash. Its resemblance is so striking that chemists have adopted as an explanation the existence in ammonia compounds of a radicle NH_2 , which they class among the metals on account of its chemical behaviour, although the compound itself of this formula has never been isolated.

Salts.—A salt is formed when, in suitable circumstances, an acid and a base react upon each other. For example, when sulphuric acid is added to solution of caustic soda, the sodium radicle unites with the SO_4 and forms sodium sulphate, whilst the OH radicle in the caustic soda and the H radicle in the sulphuric acid unite to form water.



Salts may be formed in many other ways than this, but this serves best to emphasise the two components which go to form the salts. In the old days chemists wrote the formulæ of salts so as to preserve a representation of the metallic base and the acid anhydride entering into their composition. For example, sodium sulphate was written $\text{Na}_2\text{O}.\text{SO}_3$.

While this served its purpose, the modern method of writing the formulæ of salts (by radicles) better represents their chemical behaviour in chemical changes.

It must be understood that if an acid and a base, both in solution, are mixed together, the formation of the salt necessarily takes place, and if the acid and base are in exactly equivalent proportions, nothing but the salt in question then exists in the solution. If either acid or base is in excess then so much of one or the other is left over. A little knowledge of chemical changes of this kind would have saved the writer of a paragraph which, I am told, appeared years ago as an instruction for the making of a universal cleanser for photographic dishes and bottles. Recognising that some substances are better removed with acids and some with caustic bases like sodium hydroxide, the writer recommended the use of the two in admixture for the purpose of achieving both ends at once!

ACID AND ALKALINE.

In ordinary chemical manipulation we regard an acid as the opposite of an alkali and *vice versa*. While it is quite true that many bases are very strongly alkaline in the sense that they turn red litmus paper blue and have a certain smooth feel to the fingers, yet from the chemical standpoint the question whether a substance is acid or alkaline in this way has nothing at all to do with its being a base. A salt may be acid or alkaline, as we shall see directly. Moreover, a salt which the chemist would call "neutral" may be strongly alkaline. The practical properties of a salt as regards its being alkaline or otherwise depend upon the respective character of the acid and the base concerned in its composition, and this brings us to say something about strong acids and weak acids, strong bases and weak bases.

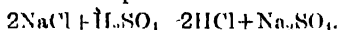
OTHER PROPERTIES OF ACIDS.

Generally speaking, acids are substances which readily enter into chemical combination. The chief mineral acids—sulphuric, hydrochloric, and nitric—are bodies of most intense chemical activity. All three of them act energetically on many metals. Nitric acid, in particular, dissolves metals such as silver, iron, copper, lead, zinc—in fact, almost any metal which is attacked by an acid—forming a nitrate. Sulphuric acid on

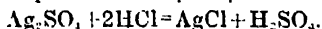
the other hand, dissolves a few metals freely, such as zinc, iron, and magnesium, but in the ordinary way, when mixed with water, has very little action upon copper or lead. Hydrochloric acid is an active solvent of zinc (as in killing spirits for soldering), of iron and magnesium; but in the cold and when mixed with water, has comparatively little action upon lead or silver.

Acids also act as solvents upon many substances, such as chalk and lime, but this kind of solution is quite different from dissolving, say, hypo, in water. The chalk or lime dissolves because a fresh and soluble compound, say, calcium chloride, is formed by the action of hydrochloric acid. If you evaporate the solution you will not get the lime or chalk back again, as you will get the hypo by boiling down a solution of that salt.

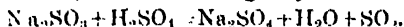
As regards the relative "strengths" of acids, their degree of chemical activity depends largely on circumstances, but the three acids already named—sulphuric, hydrochloric, and nitric—are what are termed "strong" acids, and, broadly, sulphuric acid is the strongest of the three—strongest, that is to say, in the sense that it can turn out nitric or hydrochloric acid from the combination of one or other of these with a base and take its place. Thus, if ordinary common salt (sodium chloride) is heated with sulphuric acid, hydrochloric acid gas is given off, and sodium sulphate remains behind.



The same kind of change goes on if sodium nitrate be heated with sulphuric acid; but, on the other hand, if you add hydrochloric acid to a solution of silver sulphate the SO_4 radicle is turned out and its place taken by Cl radicle, and silver chloride deposited as a precipitate.



Here, no doubt, the predisposing cause is the insolubility of the silver chloride. In a general way, however, sulphuric acid is the king of acids, and displaces other acid radicles from their combination with bases. A common example in photography is the addition of sulphuric acid to a solution of soda sulphite. The acid displaces the sulphurous acid of the sulphite, the latter splitting up into water and the gas SO_2 , which is recognised by its pungent smell, that of burning sulphur.



Sulphurous acid is a very weak acid, as witness the fact that it is the only common acid which is without decomposing effect upon hypo. If you add any acid in small or large quantity to a solution of hypo you will find that sooner or later, according

to the quantity of acid added, the hypo solution will become milky or opalescent, and once this change has begun will often become almost muddy. Sulphurous acid, on the other hand, if pure, will not affect hypo in this way, but by itself it is not an advisable means for forming an acid fixing-bath, for the reason that it easily becomes changed by oxidation (of which later) into sulphuric acid, which then causes the decomposition of the hypo. It is for this reason that in the compounding of acid fixing-baths it is usual to introduce a considerable quantity of sulphite of soda, sufficient to take up into a state of combination any sulphuric or other acid which may be used; also to take up, if sulphurous acid is used, any sulphuric acid which is produced by its oxidation.

Another very weak acid is carbonic acid. It has hardly any existence by itself, since it is known only as a solution of carbon dioxide gas in water which is very feebly acid, though the carbonates, as we shall see later, are exceedingly powerful and important salts.

There is another respect in which acids differ definitely from each other. Some, as we have learnt, such as hydrochloric acid, contain only one atom of hydrogen. It is clear, therefore, that they can form only one kind of salt, since either the whole or else none at all of the hydrogen is replaced by a metal. But other acids, such as sulphuric and carbonic acid, contain two atoms of hydrogen which are replacable in this way by metals, and thus can form two series of salts, one in which only one atom is replaced and another in which both have been replaced. For example, there are two sulphates of soda: one the so-called Glauber's salt, and formed by replacement of the two hydrogen atoms in sulphuric acid by sodium, and the other acid sodium sulphate, or as it is also called, sodium hydrogen sulphate, in which only one atom has been replaced. The formulæ are respectively:



The latter of these two sulphates is a good example of an acid salt. Though it is a white solid substance it is nevertheless strongly acid, and, in fact, is a convenient chemical for the manufacturer of photographic preparations who wishes to introduce an acid into some mixture of chemicals without the necessity of enclosing it specially in a glass tube, as would be necessary in using sulphuric acid itself.

Carbonic acid in a similar way forms two series of salts, which in the case of sodium are ordinary sodium carbonate and the so-called bicarbonate as sold by grocers in the form of a fine powder under the confusing name of "carbonate of soda." It is really the counterpart of the acid sodium sulphate, although for a reason which we shall come to in the

next paragraph it is not an acid substance. The formulæ of these two carbonates (leaving out of account the water with which sodium carbonate usually crystallises) are respectively:—



Still another acid (phosphoric) contains three atoms of hydrogen, one, two, or all three of which can be replaced by a metal. The formulæ of these salts are respectively:—



PROPERTIES OF BASES.

Bases differ from each other even more markedly and sharply than acids. The two chief bases are those derived from the metals sodium and potassium. These metals combine with the greatest energy with oxygen forming the oxides Na_2O and K_2O , and these oxides in turn unite with the greatest avidity with water forming the so-called hydroxides (caustic soda and caustic potash) of the formulæ NaHO and KHO . Akin to these and equally important in practical chemistry is the strong solution of ammonia which chemists regard as the hydroxide of an imaginary element ammonium, and to which they give the formula NH_4HO . These three are the common strong bases used in the manufacture of salts and compounds of all descriptions. These bases possess the power of neutralising acids (forming salts) in the proportion of their atomic weights. It will thus be seen that in this respect caustic soda goes almost twice as far as caustic potash owing to the much smaller atomic weight of sodium, whilst ammonia goes further still. But as regards their chemical energy, using this word to denote the ability of these alkalis to stimulate any chemical reaction to take place, caustic potash is distinctly superior to caustic soda. Certain chemical changes—for example, the manufacture of oxalic acid from sawdust—can be carried out by aid of caustic potash, whereas they do not take place at all with caustic soda. Probably the greater energy of caustic potash in photographic developers is a phenomenon of the same kind.

All these so-called alkalis are very soluble in water, forming solutions which feel slippery to the fingers and corrode the skin. They all are powerful cleansers of anything in the nature of grease or fat, which is converted by them into soap. They all exert a more or less pronounced corrosive action on glass, and for this reason the solutions of the two solid alkalis, caustic soda and caustic potash, should be kept in bottles sealed with a cork or rubber (not a glass) stopper, otherwise the action of the alkali is liable to cause the stopper to stick permanently in its place.

All these bases, too, absorb carbon dioxide gas from the air, becoming thereby converted into the respective carbonates. For this reason caustic potash or soda as purchased is very rarely free from carbonate, particularly if it has been exposed much to the air, and a solution of any of the caustic alkalies accumulates carbonate in use as the bottle is opened from time to time.

Another base which has properties resembling these strong alkalies, although to a far feeblor degree, is lime or oxide of calcium. The difference in its properties is marked by its very slight solubility in water, but it is equally a strong absorber of carbon dioxide, becoming thereby converted into carbonate of lime, the material of natural chalk and limestone.

When we come to the bases formed by the other metals other than those just mentioned we find that they are "weak." In almost all cases they are insoluble in water and are formed by adding a solution of caustic soda, caustic potash, or ammonia to a solution of one of their salts. Thus, by adding a solution of either of these alkalies to one of ferric chloride (perchloride of iron) there is thrown down a bulky reddish precipitate consisting of ferric oxide loosely combined with water and usually termed ferric hydroxide. It is this precipitate which is used as the starting point for the manufacture of ferric oxalate in the preparation of sensitising solutions for platinum and other iron printing papers. The precipitate can be washed free from any excess of alkali and from the chloride salt which is formed in producing it from the ferric chloride by repeatedly stirring it up in water and allowing it to settle, or by washing it on a flannel bag. I instance this process as a reminder that the caustic alkalies throw down precipitates of this kind from solutions of almost all the metallic salts—e.g., from those of lead, mercury, silver, copper, aluminium, and chromium. For this reason salts of these metals are "incompatible" with a solution containing a caustic alkali—that is to say, you can't have both existing in one and the same solution. This, perhaps, will afford one explanation to those who carry out experiments in the making up of mixtures for photographic use why a mixture formed by adding one perfectly clear solution to another becomes instantly muddy.

SALTS FROM VARIOUS ACIDS AND BASES.

From what has just been said, the reader may, perhaps, anticipate that salts will exhibit a particularly marked character according as they are formed from a strong base and a weak acid, from a weak base and a strong acid, or from a strong base and a strong acid. Well, that is so, and one can point to three of the chemical substances commonly used in

photography which very well illustrate the differences resulting from one or other conjunction of an acid and base of different characters. Take, first, by way of example, ordinary carbonate of soda of the formula Na_2CO_3 , and formed from the strong base of sodium and the weak acid, carbonic acid. Judged from the formula, the chemist calls this the "normal" carbonate, or, as some of the text-books term it, the "neutral" carbonate. But, as the reader knows, sodium carbonate is a strong alkali, only inferior in this respect to the caustic alkalis. Although chemically it is a salt, it behaves, in its action upon solutions of the heavier metals mentioned in the previous paragraph, very much like a solution of a caustic alkali. It throws down precipitates, not of the bases or hydroxides of these metals, but of their carbonates. Like caustic soda, sodium carbonate is an energiser of photographic developers, though to a milder degree. Like the caustic alkalis, carbonate of soda (also carbonate of potash and carbonate of ammonia) neutralises acids, forming salts with evolution of carbon dioxide gas. So far as neutralising acids is concerned, the carbonates replace the caustic alkalis in the proportion of their molecular weights. For example, 106 parts of sodium carbonate (anhydrous or dry) will replace 80 parts of caustic soda, but no relation of this kind exists so far as concerns the quantity of sodium carbonate which can replace a given quantity of caustic soda in a photographic developer. There, it is not a question of neutralising an acid, but of, in some way, energising the developer proper.

A good instance of a salt formed from a weak base and a strong acid is ordinary alum, formed from the weak base of aluminium and sulphuric acid. Hence we find that this is an acid substance. In order to render a solution of it neutral it is necessary to add a little of a caustic alkali like soda or potash, or of a carbonated alkali like sodium carbonate, up to a point at which the base of aluminium hydroxide begins to be thrown down in the form of a white bulky precipitate.

Our third instance—that of the salt formed from a strong base and strong acid—is oxalate of potash, which, when chemically pure, is strictly neutral to litmus test paper. It is neither acid nor alkaline; the "strengths" of the acid and base entering into its composition are so balanced that the result is a neutral salt.

A very good instance of the three descriptions of salts which may be formed from one single acid is that of the three phosphates of soda. These have the formulæ:—



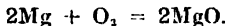
These three salts range from acid to alkaline, according to the number of atoms of sodium (forming the strong basic radicle)

which enter into the substance. Thus the first of the three is an acid substance, the second is feebly alkaline (it is the ordinary sodium phosphate, which is meant when "phosphate of soda" is prescribed without qualification in photographic formulæ), whilst the third, the so-called tri-basic phosphate, is a strongly alkaline substance, suggested by MM. Lumière as a substitute for carbonate of soda in photographic developers.

FORMS OF CHEMICAL ACTION.

It would be impossible in the course of this article to deal with the many ways in which chemical compounds are formed, but we can look at a few of them, and particularly those of which there are examples in ordinary photographic work.

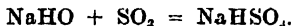
One form is that in which elements combine directly together, usually under the action of heat or the electric spark. We have already had one instance of this in the combination of sulphur and iron. Another is the combination of magnesium and oxygen to form white oxide of magnesia when a piece of magnesium ribbon is burnt.



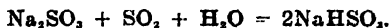
But most chemical changes take place not between elements but between compounds of a greater or less complexity. A very common kind of change is that in which a base, such as oxide or hydroxide of soda, combines with an acid or with what is called the "anhydride" of an acid—that is to say, an acid deprived of the elements (hydrogen and oxygen) of water. For example, if the gas sulphur dioxide (the anhydride of sulphurous acid) is passed into solution of caustic soda it forms sulphite of soda, according to the equation



If the caustic soda is in only half the proportion the compound which is formed is the so-called acid soda sulphite, the change being represented thus:

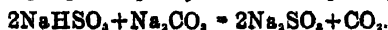
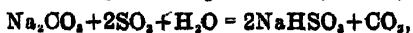


From this it will be understood that in the ordinary course the first product is ordinary soda sulphite, whilst if the caustic soda is exposed to the full to the action of the sulphur dioxide gas the final product is the acid sulphite, the soda sulphite first formed being subsequently converted into the acid sulphite.



In the manufacture of soda sulphite upon the large scale it is a plan of this kind which is followed:—Sulphur dioxide is passed into soda carbonate solution until it is acid (from the formation of sodium acid sulphite). To this liquor (boiling)

sodium carbonate is then added as long as carbon dioxide is evolved. The two stages are represented by the equations:—

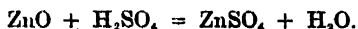


Another form of chemical action is that of an acid upon a metal. For example, when zinc is put in dilute sulphuric acid there is a brisk ebullition of gas (hydrogen), and zinc sulphate is formed. In other words, the metal displaces the hydrogen from the acid and forms a salt.

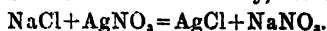


A similar change goes on in "killing" hydrochloric acid (spirits of salts) in making soldering fluid. Here the hydrogen is again discharged from the acid and chloride of zinc formed.

But if oxide of zinc is dissolved in an acid we have an instance of the combination of an acid and base. The action differs in the fact that the zinc is already in combination with oxygen, and that this latter combines with the hydrogen in the sulphuric acid to form water.



But the kind of change which most frequently takes place in ordinary chemical operations is that which is known as double decomposition—that is to say, the action of one salt upon another which leads to an exchange of the two partners (basic radicle and acid radicle) forming each. For example, if you add to a solution of silver nitrate a little solution of ordinary common salt or of any other chloride you immediately get a curdy precipitate thrown down—namely, silver chloride.



This precipitate is, of course, easily recognisable—for instance, it speedily turns a violet colour on exposure of the vessel containing it to the light—but it is not so clearly recognisable that it is only one of the two new compounds which are formed. The other (sodium nitrate) remains in the solution. If the quantity of salt and silver nitrate are weighed out so that they are in the exact proportion of their molecular weights, then the only substance left in the solution will be the sodium nitrate in quantity equivalent to the weight of sodium chloride or of silver nitrate. It is this soluble salt which has to be washed out in making a gelatine or a collodion emulsion, in the manufacture of which a double decomposition, such as is represented in the last equation, is the method invariably adopted for forming silver chloride, silver bromide, or silver iodide. The dry-plate maker, after he has mixed his emulsion, therefore allows it to set, shreds it by passing it through coarse fabric,

and then washes it in water in order to remove the soluble salts.

Those who use the copper intensifier will have come across exactly such a similar change. In making the bleaching solution, a strong solution of copper sulphate is mixed with one of potassium bromide. The result is to form a deep greenish solution containing a considerable quantity of crystalline matter. Here it is the soluble body, the copper bromide, produced by the double decomposition that one wants to use: the other new salt, the sulphate of potash, is allowed to settle out, and the clear solution poured off from it. If we put down the symbols for the change which takes place in making this mixture, the reader will see what it is that goes on.



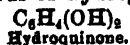
What I have sought to impress upon the reader is that in forming new compounds by mixing two different substances together in solution with the formation of a precipitate which is altogether insoluble in water, like silver chloride, or is so slightly soluble that much of it is deposited, as in the case of the sulphate of potash, we have to bear in mind that there are always two new compounds formed, and that very often the one which is not the chief object of making the mixture may affect the use of the latter, and that, therefore, its formation also requires to be borne in mind.

OXIDATION.

Another species of chemical change of the greatest and most far-reaching importance in chemistry is that of oxidation. By oxidation is meant the addition of oxygen to the molecule of a compound, or equally the removal of hydrogen from it. A solution of sulphurous acid, even when kept in a bottle, and more rapidly if freely exposed to the air, is "oxidised" by the latter forming sulphuric acid. The respective formulæ of sulphurous and sulphuric acid mark this change.



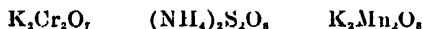
On the other hand, by suitable treatment, hydroquinone is converted into the substance quinone. Hydroquinone oxidises in this way in the ordinary course of using a hydroquinone developer, but, as the respective formulæ show, the change is one of the removal of hydrogen, not the addition of oxygen.



But we must expand this definition of oxidation a little further. By oxidation is understood not merely the addition of oxygen itself but of elements or radicles which play a part

which is chemically similar to that of oxygen. The conversion of silver into oxide of silver is a process of oxidation, and so equally is the conversion of silver into silver chloride, silver bromide, or silver iodide. We shall see directly that changes such as this, which are accomplished by means of so-called "oxidising agents," form the basis of the many processes of intensifying and reducing negatives.

But not to interrupt what we are now considering, it will be understood that oxidising agents are chemical bodies which can add oxygen or similar elements to other substances. Thus oxygen itself, as it exists in the air, is the most widespread oxidising agent, and is responsible for such forms of oxidation as the rusting of metals and the "spoiling" of many substances, such as photographic developels, which come under its invisible action. Similarly, chlorine, bromine, and iodine are oxidising agents in the approved sense that they can add to certain compounds the elements chlorine, bromine, and iodine. But most of the oxidising agents, as they are familiarly understood, are compounds containing a large proportion of oxygen, or an element akin to it. In photography, perhaps, the three best known oxidising agents are potassium bichromate, ammonium persulphate, and potassium permanganate. The formulæ of these bodies mark their large content of oxygen:—



We may recall the uses of these compounds in photographic manipulation by way of instancing their oxidising character. Potassium bichromate, in admixture with sulphuric acid, is such an intensely powerful oxidising agent that it is commonly used for cleansing dishes, measures, etc., from any description of "dirt." Most of the deposit which forms in and clings to photographic utensils is either some kind of insoluble mineral salts, or else is matter derived from developers. The acid dissolves, or, at any rate, loosens most mineral insoluble matter, whilst the products of developers, etc., are energetically oxidised and at the same time rendered soluble by the bichromate in the acid state.

Ammonium and other persulphates, as also potassium permanganate, are used as chemical "destroyers" of hypo in negatives or prints. The term "destroyer" is a misnomer, for, obviously, the atoms forming the hypo cannot be annihilated out of existence, but in the presence of such powerful oxidisers as persulphate or permanganate the hypo is converted into some other compound (or compounds), the effect of which, if left in the print, is, so it is hoped, harmless to the image forming the photograph. Probably the final product of the oxidation of hypo by such vigorous agents is sulphate of soda, although there is some doubt on this point.

But, apart from these vigorous oxidising agents, there are others which are milder in their action, and are therefore more suitable for use upon so susceptible a material as the silver, existing in a fine state of division, which forms the image of a negative or print. Such oxidising agents are ferric chloride (perchloride of iron), potassium ferricyanide, mercuric chloride, and copper bromide. These convert the metallic silver of the photographic image into some compound or other in which the silver exists in a more oxidised state. These silver compounds, as we shall see directly, are amenable to the action of other chemical reagents, by means of which the original silver deposit may be removed (reduction), or may be added to (intensification).

OXIDISABLE SUBSTANCES.

The fact that an oxidising agent can exert its action upon some other body naturally implies that that body is capable of forming a more highly oxidised compound. Thus metals (which are not combined with any oxygen at all) are highly susceptible to oxidation, but as regards the general run of chemical substances "oxidisability", (to coin a word) implies the power of a substance to form a compound containing a larger proportion of oxygen or similar elements. Thus a substance like ferrous sulphate (green protosulphate of iron) is readily oxidised, and thereby converted into ferric sulphate or some other ferric salt, the base of which is an oxide of iron containing a larger proportion of oxygen than that forming the base of ferrous sulphate. In this way these two states of oxidation of the element iron mark two distinct series of iron salts—the ferrous and the ferric—the difference between the two being that in the latter the iron is in a more highly oxidised state.

It must be understood, too, that "oxidisability" is all a matter of degree, depending upon the power or activity of the oxidising agent. Thus, free oxygen in the air is powerless to effect certain processes of oxidation which take place instantaneously by the aid of an oxidising compound. Hypo, for example, undergoes practically no oxidation in the air, but is rapidly oxidised by bodies like bichromate or permanganate. The metals gold and platinum resist the oxidising action of almost every chemical substance, but can be oxidised by a mixture of hydrochloric and nitric acids—the so-called *aqua regia*.

REDUCTION.

Chemists, however, commonly look upon this property of oxidisability as an active rather than as a passive property of a body. It is purely a matter of words, but it is more usual to speak of a body which can be readily oxidised as having

"reducing" properties—that is to say, of being able to remove oxygen from other compounds or add hydrogen to them. In other words, the process of reduction is the converse of that of oxidation, and a substance which is able to bring about this reduction is spoken of as a "reducing agent." A substance is a reducing agent because it is very readily oxidised. For example, we learnt in a previous paragraph that hydroquinone when oxidised forms quinone. Thus, hydroquinone acts as a reducing agent, and functions in that capacity when used as a developer of plates. We have just noted that sulphate of iron is readily oxidised to ferric sulphate. It also is thus a reducing agent, and exhibits that property in a particularly vigorous way towards silver nitrate. If you add a few drops of ferrous sulphate solution to one of silver nitrate, there is immediately produced a black precipitate or deposit of metallic silver. The ferrous sulphate has "reduced" the silver nitrate to the metallic state, and is used for that purpose as the developer in the wet-collodion process, the vigour of its action being restrained by the addition of an acid. A ferrous salt (produced by the action of light) plays the same part in the platinum printing process. In the "developer" it throws down to the metallic state the metallic platinum present as platinum salt in the coating on the paper, and thus replaces the semi-visible image, which is seen when the paper is withdrawn from the printing frame, and consists of ferrous salt, by one of full black intensity consisting of platinum metal.

Of the photographic substances which thus act as chemical reducers are chiefly to be mentioned the various developers, pyro, hydroquinone, etc., sulphites and metabisulphites, which latter are used as preservatives of developers and presumably serve this purpose by exerting a stronger attraction for the oxygen of the air, or that dissolved in the stock solution than the developing substances themselves.

PHOTOGRAPHIC "REDUCTION" IS OXIDATION.

It will no doubt have been clear from the foregoing that the process of reducing a negative, as the term is used in a photographic sense, is really one of oxidation. The silver of the negative image is treated with some oxidising agent which converts it at once either into a compound which dissolves away in water or into some other compound which can be dissolved by some solution or other which leaves the original image itself unaffected. Ammonium persulphate is an example of a reducer (photographic) which oxidises and dissolves the silver image at the same time, but in the use of most reducers

Different substances require to be employed for these two distinct purposes. Not so many years ago it was common practice to carry out reduction of a negative in two steps:—(1) Oxidising the silver image in part, say, by a solution of ferric chloride, and thus converting part of it into silver chloride and then (2) dissolving out this silver chloride with hypo. The obvious drawback to such a process is that it is not easy to tell how far to carry the first stage of the process, and therefore most reducers nowadays are compounded so as to allow the two distinct operations of oxidising the silver image and of dissolving the silver compound which is produced by the oxidation simultaneously. Thus in the Farmer reducer of hypo and ferricyanide the silver image is oxidised by the ferricyanide to silver ferrocyanide, and this latter is dissolved, immediately it is formed, by the hypo.

INTENSIFICATION IS AN OXIDISING PROCESS.

Precisely similar, at the first stage, is the action of one or other of the bleaching solutions used in intensifying a negative. A solution of mercuric chloride (bichloride of mercury) oxidises the silver image to silver chloride and at the same time leaves on the negative in a loose form of chemical combination the product formed by the reduction of the mercuric chloride—namely, mercurous chloride (calomel), which is an insoluble body. In intensification, however, the next step is not to dissolve away the image which has thus been oxidised, but to apply to it some bath which will convert it into some deep-coloured compound, as is done by using a solution of ammonia or Schlippe's salt; or the bleached image, consisting of silver and mercurous chlorides, may be reduced, in the chemical sense, to metallic silver and mercury by means of an ordinary developer, and so give rise to a greater degree of density in consequence of the added mercury.

But perhaps the nicest illustration of the changes which the silver image thus undergoes is that in which a badly stained negative is treated with a powerful oxidising mixture (permanganate, sodium chloride and an acid) in order to remove the stain. This mixture oxidises the material of the stain, converting it into colourless or, at any rate, soluble compounds, whilst the silver image is converted into silver chloride. The negative has then only to be restored to its original state of metallic silver by the application of a developer in order to leave it as it was before, but minus the stain. In this way a more powerful stain remover can be applied than is possible if it be such as bleaching powder, which also dissolves the silver image.

With these instances of oxidation and reduction we can now turn to a few miscellaneous facts connected with practical photographic operations, the chemical nature of which will, it is hoped, be clear from the theoretical considerations with which we have thus far been chiefly concerned.

SOLUTIONS.

Water is the most widely used medium in which to dissolve chemical substances, and the latter vary enormously in the degree to which they can be dissolved. They range, for example, from silver chloride, which dissolves to the extent of only 1 part in 6,000,000 parts of water, to ammonium sulphocyanide, which dissolves in half its own weight of water. With practically very few exceptions substances dissolve more freely in hot water than in cold. Bichloride of mercury, for example, which will dissolve in cold water only to the extent of about 1 part in 16, dissolves in less than twice its weight of boiling water. Potassium bichromate, which in cold water requires ten times its weight for solution, dissolves in about its own weight at a boiling temperature. And there is another factor which comes into play. Some substances in dissolving greatly chill the water, and thus lower its dissolving power. Hypo is a notable instance of this, on which account it is advisable to use water as hot as, say, 120 deg. F. in making a stock bath for fixing.

But for some chemicals hot water should not be used. It should not be used for potassium metabisulphite or sodium bicarbonate, since at a temperature of much above 90 to 100 deg. F. these salts are more or less decomposed, the metabisulphite losing part of its sulphurous acid and the sodium bicarbonate part of its carbonic acid. In the case of the bicarbonate the effect of heat is to render the solution which should have been neutral more or less alkaline, a difference which in some instances, such as the making up of gold toning-bath for print-out paper, may be undesirable.

The solution obtained by dissolving as much of a substance as can be dissolved at a given temperature is known as a saturated solution, and if careful attention is given to the temperature is one means of making a solution of definite strength without weighing or measuring. In some few instances this plan is followed, as in making up the stock bleaching solution of mercury bichloride for intensification. As a rule, the most convenient method of doing this is to dissolve in hot water about as much of the bichloride as is required to saturate a given bulk of water when cold. This makes for saving of time in compounding the solution, but in the particular case of mercury bichloride it is necessary to observe a precaution. The

mercury bleaching solution is usually made up with addition of some hydrochloric acid, about half a dram to 15 ozs. of the bath, but the acid makes it possible to dissolve more of the bichloride than can be dissolved without it, and therefore in making up the stock solution the proper course is to dissolve the bichloride first in hot water, let the solution cool to the ordinary temperature, then pour it off from any of the heavy feathery crystals which have separated out, and then, and not till then, to add the acid. If this order is not followed it will be easy to get a solution that is too strong and is liable to cause the crepe-like reticulation in negatives which are intensified with it.

In making saturated solutions it is also necessary to bear in mind that a solution can be made which is "super-saturated," that is to say, temporarily contains more of the salt in a given bulk than can permanently be kept in solution. By dissolving with the aid of heat as much acetate of soda as a given bulk of water will take up, a clear solution can be made which remains clear even when it is cooled to the ordinary temperature. But if the smallest crystal of sodium acetate is introduced, the excess of salt above that corresponding with a saturated solution will separate out. The same kind of thing takes place with many salts, but generally it is only necessary to shake the cold solution well in order to cause the quantity of salts held in solution by supersaturation to separate out.

CHEMICAL SOLVENTS.

There is a sharp distinction between the solution of a salt in water and that in which its solution is brought about by the aid of some other chemical substance. In the one case the dissolved salts can generally be recovered again by allowing the water to evaporate, but a solution obtained by aid of another substance depends as a rule upon the formation of an entirely new chemical compound. Thus bichloride of mercury if mixed with about an equal weight of ammonium chloride will dissolve quite freely in cold water. Oxalate of potash is likewise a solvent of ferrous oxalate. That is why it forms the developer in the platinum printing process. It brings the ferrous oxalate into a dissolved state and so causes it to act on the platinum salt in the paper. In these two cases a species of double compound or combination of the two salts takes place. Very similar is the action of hypo in dissolving silver chloride, bromide, or iodide in plates and papers, although here it is not a case of the combination of the two substances to form a soluble salt, but the formation of a double silver hyposulphite. Silver forms several such hyposulphites, but in order to ensure the formation of the one which is freely soluble in water, it is

necessary that the hyposulphite of soda should be in large excess of the silver bromide or chloride. Hence the necessity, if permanent prints are required, of using fixing baths which contain an ample proportion of hypo and of discarding them before that excess has been appreciably diminished by the accumulation of silver in the bath.

THE PROPERTIES OF WATER.

So far as its power of dissolving a given quantity of a substance is concerned, ordinary tap-water does not differ materially from the distilled water which chemists, in their more refined experimental work, invariably use. It is sometimes directed that distilled water should always be used in making photographic solutions, and of course it is the best for the purpose and enables clear water-white solutions to be made up where the use of ordinary tap-water would introduce more or less cloudiness. But for the general bulk of developers, fixing baths, and the like, there is no real necessity to use distilled water; ordinary tap-water is quite good enough and becomes very little inferior to distilled water if the larger quantities of the impurities contained in it are removed, as they easily can be.

As supplied by the public companies water contains four descriptions of impurities, viz., lime and magnesia compounds, which render the water more or less "hard"; air, which has a beneficial effect upon water for drinking purposes, but is undesirable from the photographic standpoint; chlorides (usually common salt), in very small proportion; and, last, organic matter, a very little of which renders the water unfit for drinking, but is in no way harmful photographically, except for the making of solutions of gold or platinum, for which expensive salts, distilled water should be invariably used.

The salts of lime and magnesia exist in water in two forms—as sulphates, which are fairly soluble, and as carbonates, which are practically insoluble, but are formed in solution in the water in its passage over beds of limestone, etc., by virtue of the carbon dioxide dissolved in it. They exist, that is to say, as bicarbonates, corresponding chemically with bicarbonate of soda, and when the water is boiled these bicarbonate compounds are decomposed, the carbon dioxide is driven off, and the almost insoluble carbonate of lime or magnesia is deposited. These lime and magnesia carbonates, with some of the sulphate, form the hard crusts in boilers and the "fur" in kettles. And as usually the greater proportion of the lime and magnesia in tap waters exists as carbonates, the simple operation of boiling the water gets rid of the greater part of these mineral impurities.

Photographically, this is an advantage, because in making many photographic solutions the presence of lime salts causes more or less precipitate or deposit. It does so in the case of carbonate of soda, oxalate of potash, ammonia, and any solution containing mercury or lead. On this account alone it is just as well to use a supply of water made by boiling water in a clean iron or enamelled saucepan, letting it boil vigorously for, say, five minutes, and then leaving it by itself to cool. If the water be then poured into large bottles filled to the neck, it will remain in condition for use for an unlimited time.

In this process the second impurity, air, is also removed, and one undesirable feature of ordinary tap water thus avoided by the same process. Dissolved air is undesirable, chiefly for solutions in which pyro or other developer is to be dissolved. But, apart from the oxidising effect of the dissolved air upon the developer, it is not infrequent to find tap water, owing to the considerable pressure at which it is supplied, so charged with air that the latter, in escaping from the water, forms air-bells on plates or prints, and thus leads to the formation of white spots, due to the action of the developing solution being obstructed. On this account well-boiled and cooled water is as advantageous for the dilution of stock solutions to form the working developer as it is for the making of these stock solutions themselves.

The third impurity, chlorides, is of no importance for photographic work, except in the making of solutions of silver nitrate. If there is any chlorine in the water, a silver nitrate solution is bound to be milky, and therefore distilled water requires to be used, if a bright solution is wanted. But very often a silver nitrate solution is made up only to be mixed immediately with one of hypo (as in making up the Wellington intensifier), or in some other form in which a little deposited chloride of silver is not of the slightest importance. On the other hand, if the silver nitrate is to be combined with another solution, so as to form a perfectly clear mixture, then it is better to use distilled water for both, as, for example, in making up the intensifier for the Autochrome plate.

As regards the organic matter dissolved in water, the quantity in all waters supplied for drinking water purposes is entirely negligible, and even a quantity hundreds of times that commonly present would have no harmful effect in photographic work, unless, perhaps, for making solutions of gold or platinum salts. Such solutions, however, are of such small bulk that there is no reason for forgoing the use of distilled water.

WHY PRECIPITATES COME IN SOLUTIONS.

From what has been said in the previous paragraph it will be understood why many photographic stock solutions are not obtained of water-white clearness when ordinary tap water is used. In general it may be said that the amount of deposit which is formed as the result of *boiled* tap water is insignificant. Moreover, most of it will settle out, and in using stock solutions which have been thoroughly mixed at the time of making the supply can be drawn from the upper clear portion without disturbing the deposit at the bottom. But there are other reasons why mixtures of various salts do not form clear solutions. The reader who has borne in mind a previous part of this article dealing with chemical changes of the double-decomposition type will realise that in dissolving several different substances in the one solution it may often happen that a deposit may be formed as the result of a change of this kind. In ordinary photographic work, according to the recognised descriptions in the text-books, these reactions are not met with, or, at any rate, rarely met with, since most photographic processes have been devised so as to give the minimum occasion for difficulties in the way of chemical manipulation. But the experimenter unfamiliar with the exact reactions of the salts of the various metals is pretty certain to find that in trying one combination or another of different substances he gets a deposit thrown down. It does not call for a very wide knowledge of chemistry to be able to say in advance whether a mixture of such and such salts can be made without a deposit being formed, but it would lead us too far even to summarise the properties of the metallic compounds in this respect. The reader should refer to any text-book of qualitative analysis, but broadly it may be said that addition of any soluble carbonate (sodium, potassium, or ammonium carbonate) will bring down a precipitate if dissolved in the same solution as a salt of practically any other metal. Caustic alkalies also, such as ammonia, caustic potash, and caustic soda, behave in this way very similarly to the carbonated alkalies. They throw down the hydroxides or oxides of metallic compounds, whereas with the carbonates in most cases the deposit is the insoluble carbonate of the metal. Any soluble chloride will, under the same conditions, form a deposit with a salt of lead, silver, or mercury (in the mercurous state), these three metals forming insoluble chlorides. Copper, lead, bismuth, silver, iron, mercuric, and other compounds are precipitated by any soluble sulphide.

In some cases in dealing with deposits of mineral salts it is possible to add some neutral compound which will "keep up" (that is, prevent the deposition of) an insoluble compound. A good instance of this is offered in the formula for copper

tioning worked out by Mr. W. B. Ferguson, in which the potash citrate is used for the purpose of preventing the deposition of the sludgy precipitate of copper ferricyanide which, without the citrate, would be thrown down. Citrate of potash and equally citrate of soda, as was pointed out very many years ago by Mr. John Spiller, is a remarkable compound in thus making it possible to keep in solution many otherwise insoluble mineral salts. It is a compound which deserves to be kept in mind by the photographic experimenter in view of its usefulness for this purpose.

Another distinct cause of deposits forming in solutions is the addition to it of some other liquid in which the dissolved substance is insoluble. For example, gelatine, of which a solution of moderate strength can be made in warm or cold water, is thrown down as a deposit by addition of methylated spirit, and in like manner the pyroxylines dissolved in collodion and the resins dissolved in spirit varnishes are thrown down as deposits by addition of water.

SUBSTANCES

SPOIL.

Something may be appropriately said here on the reasons why certain substances "do not keep" that is, alter more or less through exposure to the air. Even with the small amount of air contained in a bottle such change is liable to go on and its action to be prolonged when, as is ordinarily the case, the bottle is opened from time to time. Now these changes arise from the three substances present in the air—namely, moisture, oxygen, and carbon dioxide.

Many substances absorb moisture with the greatest avidity. Chief of these, among photographic compounds, are ammonium sulphocyanide, potassium carbonate, and caustic potash and caustic soda. All of these, when purchased, require to be in securely luted bottles. Ammonium sulphocyanide is best dissolved at once, for once the bottle has been opened the salt speedily becomes almost wet, and it is a compound which cannot be restored by drying. Potassium carbonate, on the other hand, can be heated in, say, a clean baking-tin, over a moderate fire or ring gas-burner, and can thus be rendered dry.

Absorption of oxygen is responsible for the deterioration of substances which are reducing agents, *e.g.*, soda sulphite, sulphate of iron, developing agents. In most cases there is no remedy for such oxidation, at least none which is worth while on a small scale. Soda sulphite, however, which shows such oxidation, by the powdery crust on its clear crystals, may be quickly rinsed in cold water, dried between the folds of a towel, and then weighed out. It may be noted that anhydrous sulphite and potassium metabisulphite (also an anhydrous salt).

are much less liable to oxidation than the crystal form of soda sulphite.

The deteriorating effects of the carbon dioxide in the air upon photographic chemicals are exemplified upon only two substances of importance—*viz.*, caustic soda (and caustic potash) and potassium cyanide. The caustic alkalies in either the solid state or in solution greedily absorb carbon dioxide, becoming converted into soda carbonate or potash carbonate. Hence, these alkalies, as purchased, are very often covered with a crust of carbonate (soda more so than potash), and so are weakened for developing purposes. The carbonate can be scraped off from the caustic alkali, sold in stick form, after doing which it is better to weigh, say, a whole or half stick, and to dissolve it in the proportional quantity of water, rather than to endeavour to weigh out the exact quantity required by chopping off little bits from the hard stick.

Cyanide requires to be kept well stoppered for the two-fold reason that, by exposure to the air, part of its highly poisonous acid (hydrocyanic or prussic acid) is liberated by the carbon dioxide, and that it is also partly oxidised to cyanate, the latter a compound ineffective for the purposes for which cyanide is used.

Mention should be made here of certain compounds which, on free exposure to air, lose some of the water loosely combined as "water of crystallization." Crystallized soda carbonate is one of these: in a dry atmosphere the crystals lose their transparent appearance, not from any oxidation, but from loss of water. Such carbonate is, in fact, somewhat "stronger" (*i.e.*, contains more real carbonate) when of this appearance, but the difference is not one of any importance and may be disregarded.

A last way in which chemicals spoil is by volatilisation into the air, in regard to which two different conditions require to be recognised. A liquid may volatilise as a whole, as when ether, or pure alcohol, or chloroform gradually evaporates into the air. In that case you simply have less of it: what remains behind is equal in strength to the original bulk. But that is not so where the liquid is a solution of some very volatile body in a liquid like water, which evaporates only slowly. Liquid ammonia is a liquid of this kind: the highly volatile ammonia escapes from it, leaving a solution of lesser strength. On this account it is a good plan to mix strong ammonia, when purchased, with nine times its bulk of water, and in making up formulæ to take ten times the volume directed.

ORDER OF MIXING SOLUTIONS.

Usually the photographer is not under the necessity of

deciding the why and wherefore of the order in which the various substances contained in a given solution are to be dissolved. In many cases the order is not a matter of importance: in others, specific directions are given. But it may be worth while to point out, by means of one or two instances, that in certain circumstances the proper order in which substances should be dissolved, or two solutions mixed together, is of material importance, and that mishaps will occur from making the mixture in any other manner. For example, in the old days, when the ferrous oxalate developer was in common use it was always, quite rightly, the rule to make the working developer by adding the iron to the oxalate solution and not *vice versa*. The reason for that is that the ferrous oxalate which is the active substance in the developer is freely soluble only in the presence of an excess of oxalate of potash. If the oxalate solution be added to that of the iron, it is clear that at the first instant there is an excess of iron salt, and some ferrous oxalate may be thrown down as a precipitate, and may not afterwards dissolve. The result in that case will be a muddy developing solution, which will lead to staining of the whites of the prints. It is, in fact, a general rule in practical chemistry that in such circumstances as these it is much easier to keep a substance in solution than to re-dissolve it once it has been deposited.

Another good instance of right and wrong order is that in the mixing of an acid fixing bath composed of a mixture of hypo, sulphite of soda, and an acid. It has been mentioned in an earlier paragraph that hypo is readily decomposed by acids, with the solitary exception of sulphurous acid. Hence, in making up the formula just mentioned for an acid fixing bath, the order should be such that the hypo is not brought in contact with the acid except in the presence of the protecting sulphite. The proper course is thus to mix the acid and sulphite thoroughly together in solution and then to add this mixture to the hypo, previously dissolved. It is quite wrong to add first the acid and then the sulphite to the hypo solution, and even if the order of the acid and sulphite be reversed, it is quite possible, owing to a local excess of acid before the whole is thoroughly mixed, to cause a certain amount of decomposition of the hypo. While it is impossible to deal at length with the reason for this or that order in making up photographic solutions, these instances will serve to remind the reader that there are reasons for adopting a given order, and, therefore, reasons why it should not be departed from.

OBITUARY OF THE YEAR.

Among those whose deaths have taken place since the publication of the 1916 ALMANAC are:—

Vero C. Driffield (Nov. 14, 1915)	Lord Redesdale (Aug. 17, 1916)
Raphael Meldola (Nov. 16, 1915)	H. A. Chapman (Nov. 30, 1915)
Silvanus P. Thompson (June 12, 1916)	William Barry (July 2, 1916)
	J. L. Russell (Nov. 21, 1915)
	Frank Haes (Jan. 7, 1916)

VERO C. DRIFFIELD.

Mr. Driffield was born on May 7, 1848, at Prescott, Lancashire. His father was coroner for the West Derby division of Lancashire for thirty-one years. He was educated at the Liverpool Collegiate Schools during the head-mastership of Dean Rowson, at the Sandbach Grammar School, and at a private school in Southport presided over by a Swiss, Mr. Kuecht. In 1863 he had already commenced the practice of photography, and he spent six months, prior to his apprenticeship to the mechanical engineering in 1865, in the studios of Mr. Henry Sampson, a well-known professional photographer in Southport. In 1871, after serving his apprenticeship, he was engaged by Messrs. Gaskell, Deacon, and Co., alkali manufacturers, Widnes, as engineer, and was appointed manager of their Gaskell Deacon Works on the formation of the United Alkali Co., Ltd. It was in 1871 that he first made the acquaintance of the late Dr. Hurter, an acquaintance which soon ripened into a firm friendship. The friendship was, no doubt, mainly due to the great similarity in their tastes, and was possibly further strengthened by Driffield's part education under Swiss tuition, the most important part as he considered it. In 1876 he first enlisted Dr. Hurter's practical interest in photography, and in this first year their photochemical investigations may be said to have commenced. Their first paper was published in the "Journal of the Society of Chemical Industry" in the year 1890, and the last paper in which they collaborated was published in the "Photographic Journal" in 1898. Dr. Hurter died in 1898.

Although great discussion has scarcely ever ceased to range around the pioneer work in sensitometry which Driffield carried out in collaboration with Hurter, scientific photographic workers in all countries have been unanimous in their high valuation of the indebtedness to these two investigators. Their earlier work

undoubtedly contains errors of experiment and deduction, and their papers unfortunately gave rise to misconceptions by their somewhat loose use of technical expressions. Nevertheless, to them must be accorded the honour of first establishing and then elaborating the methods of sensitometric measurement which have contributed more than anything else to the development of the manufacture of photographic dry-plates upon a scientific basis. The most important papers of Hurter and Driffeld appeared in the "Journal of the Society of Chemical Industry."

Under the auspices of the Royal Photographic Society a memorial lectureship, jointly in the names of Hurter and Driffeld, has been established. Some £500 has already been subscribed, and the fund will, it is hoped, prove sufficient to permit of the re-publication of the papers, etc., by the two investigators.

RAPHAEL MELDOLA, F.R.S.

Professor Meldola was one of the most distinguished of English chemists. For many years he was Professor of Chemistry in Finsbury Technical College, resigning this position in 1912 in order to take the chair of Professor of Organic Chemistry in the University of London. His special subject of a great deal of valuable research work was the chemistry of coal-tar dyes. He rendered great services to the coal-tar dye industry as a consulting chemist, and was himself the discoverer of many new products and processes. His published papers on chemical and other subjects reached a total of over 300, whilst he had occupied the presidential chair of the Chemical Society, the Society of Chemical Industry, and the Society of Dyers and Colourists. Photography had long been a recreation in which Professor Meldola found congenial scope for the application of his chemical knowledge. His "Chemistry of Photography," published in 1891, is still a text-book which provides the most useful review of the chemical principles of photographic processes, written in a style which is adapted for the instruction of elementary students and, unlike many text-books, specially seeking to foster the habit of experiments among students of photography.

SILVANUS P. THOMPSON, F.R.S.

Professor Thompson was one of the comparatively few scientific men of the first rank who were authorities in quite distinct branches of knowledge. His special subject was electricity, and every student of that science must be familiar with his "Elementary Lessons in Electricity and Magnetism," which is, perhaps, the most widely used text-book of the subject for the first-year student. Professor Thompson was also the author of many other treatises dealing with the more complex branches of electrical technics. But optics was equally a subject in which he did a good deal of work and of which he was an exceptional expositor. It will be remembered that the Traill-Taylor Memorial Lecture was delivered by Professor Thompson in the year 1901, when he took for his subject "Zonal Aberration." On that occasion, in addition to developing the theory of the phenomenon, he delighted his audience with a fasci-

nating series of experimental demonstrations, a species of scientific conjuring in which he was exceptionally adept. Professor Thompson was also the author of several text-books on light, of which his "Light, Visible and Invisible," is perhaps the best known. He was also the translator of that section of Lummer's large treatise on optics which deals with photographic lenses.

As a popular lecturer he was without rival. His courses of children's lectures at the Royal Institution were models of what such education should be, full of experiments and humour, and free from the scientist's formidable vocabulary, by which so many children are alienated from a love of science in their schooldays.

LORD REDESDALE.

In Lord Redesdale the world of society, and, in particular, society circles interested in art and literature, have lost a distinguished figure. As Algernon Bertram Mitford Lord Redesdale spent an important part of his life in the foreign diplomatic service; for a short time at Petrograd, afterwards at Peking, but chiefly in Japan. Within a surprisingly short time he mastered the spoken Japanese language, and subsequently devoted much of his time to preparing an English version of Japanese folk-tales and stories, the collection of which has long been a popular volume under the title of "Tales of Old Japan." R. L. Stevenson, in his essay, "Books Which Have Influenced Me," said that it was the volume which first showed him the right relation of a man to the laws of his country.

In 1873 Mr. Mitford (as he then was) returned to Europe, and in the following year was appointed Secretary to the Commissioners of Public Works and Buildings, an office which he held until 1886. In that year, on his succession to the estates of his cousin, he settled down at Batsford, near Moreton-in-the-Marsh, and in addition to the pursuits of a country gentleman, continued to interest himself actively in the administration of the national art collections. He took an active share in the arrangement of the Wallace Collection at Hertford House, and was a trustee of the National Gallery. Landscape gardening was also a hobby of his, which he had taken up as the result of his residence in the East. It was he who was responsible for the picturesque dell in Hyde Park, by the side of Rotten Row. King Edward consulted him on the arrangement of the gardens in Buckingham Palace, and his help had previously been accepted by the King in regard to the restoration of Sandringham Park. Lord Redesdale's "Memories," issued a few months before his death, is perhaps the most interesting collection of reminiscences published during the last quarter of a century. The author had travelled nearly everywhere, and had been on more or less intimate terms with all kinds of people.

As President of the Royal Photographic Society from 1910 to 1912 Lord Redesdale distinguished his years of office by two admirable presidential addresses, the first on Leonardo da Vinci, and the second on the early history of paper. Despite his great age he presented the

appearance of vigorous health, his one apparent infirmity being his deafness, a disability which at times, in his chairmanship of R.P.S. meetings, was not without its humorous consequences.

H. A. CHAPMAN.

For many years Mr. Chapman was the leading photographer in Swansea, and from very small beginnings had built up a large business. He was, however, more than a successful business man, for he was associated with the municipal life of the South Wales borough in many ways, and, moreover, was a most familiar figure in photographic gatherings in London by his long connection with the Professional Photographers' Association, and his Presidency of that body in 1908-9. One of the old school, Mr. Chapman was never happier than when narrating struggles of his early life, or when offering advice and encouragement to younger photographers from his own long and wide experience.

WILLIAM BARRY.

Mr. Barry, of Hull, was for many years a well-known and respected figure in professional photographic circles in the North of England. Physically, he was a man of commanding presence, over 6 ft. in height, and of strong physique, the outcome no doubt of a life-long fondness for outdoor exercises, and particularly for cycling. In company with other enthusiastic cyclists, he had visited in his time most parts of the United Kingdom.

His Hull studios were for many years the places of prosperous photographic businesses, and he did much to maintain the status of high-class professional portraiture in his district. He became a member of the Professional Photographers' Association on the establishment of that body, and for a number of years until his retirement accorded it his aid and support.

J. L. RUSSELL.

For many years head of the firm of J. Russell and Sons, Limited, Mr. John Lemmon Russell, was well known as a photographer of Royalty. The business was established in Chichester many years ago by Mr. Russell's father, but until almost the day of his death the deceased gentleman took an active part in it. While other photographers have been particularly associated with the making of studio portraits of Royal personages, the business of Messrs. Russell has been largely characterised by the great amount of work it has done in the portraiture of distinguished people "in the field." Many groups of great interest for their representation of crowned heads on sporting and other expeditions stand to Messrs. Russell's credit.

FRANK HAES.

A link with the older generation of photographers was severed in the death of Mr. Frank Haes, for many years a prominent figure in photographic circles. Mr. Haes was many years ago associated with Mr. Melluish in the production of the first practical roller-

slide, and later gained celebrity for a very fine series of photographs of animals in the Zoo taken upon wet-collodion plates. He was a very popular member of the late Photographic Club, as well as the R.P.S., his unfailing geniality causing him to be always surrounded by a group of kindred spirits.

Among others who have been removed by death during the past twelve months are Oliver Dawson, formerly associated with the exploitation of the "Thames" colour plate; J. T. Ashby, a former contributor on art topics to the photographic Press; Charles Stuart, London, John Edward Shaw, Huddersfield, and G. G. Mitchell, Edinburgh, professional photographers; whilst the world of amateur photography has lost enthusiastic workers in the persons of G. D. Macdougall, Dundee, and J. W. Wright, Sheffield. The deaths have also taken place of C. Lees Curtis, partner in the scientific instrument business of Charles Baker, and of R. Krayn, inventor of the carbon film tissue, and of a now obsolete method of colour photography known by his name.

EPITOME OF PROGRESS.

BY THE EDITOR.

In the following pages will be found classified abstracts of papers, communications, and articles describing progress in technical photography (art topics are excluded) which have appeared in the British and foreign Press during the twelve months October 20, 1915, to October 20, 1916.

The general arrangements of the Epitome will be seen from the contents of the ALMANAC, which follows the title-page. Each item is separately entered in the index at the end of the volume, and a list of the journals abstracted will be found at the conclusion of the Epitome.

In a number of cases where information additional to that in the abstract has appeared in the "British Journal of Photography," a reference to issue and page has been given.

I.—GENERAL.

EVENTS OF YEAR 1916.

1916 was the period including the 18th to the 30th months of the European war between Germany, Austria-Hungary, Turkey and Bulgaria (Central Powers) and Great Britain, France, Russia, Belgium, Servia, Japan, Italy and Roumania (Allies), which opened August 1, 1914.

Jan. 11.—Award of R.P.S. Progress medal to M. André Callier for his work in sensitometry and investigations of scatter.

Aug. 21 to Sept. 30.—Sixty-first Exhibition of the Royal Photographic Society, held at the Galleries of the Royal Society of British Artists, Suffolk Street, Haymarket. ("B.J.," Aug. 25,

p. 467, and Sept. 1, p. 479, 1916.) Selecting and Hanging Committee:—Pictorial section: A. L. Coburn, H. E. Corke, John H. Gear, J. Dudley Johnston, and W. L. F. Wastell. Colour transparencies: F. T. Hollyer and W. L. F. Wastell. Scientific and technical: Adolphe Abrahams, C. E. K. Mees, R. Kearton, F. Martin-Duncan, A. J. Newton, J. W. Ogilvie, G. H. Rodman, and Captain Owen Wheeler.

Sept. 16 to Oct. 14.—Seventh exhibition of the London Salon of Photography. Held at 5a, Pall Mall East, S.W. ("B.J.," Sept. 22, p. 516, and Sept. 29, p. 530, 1916.)

Oct. 10. Nineteenth Traill Taylor Memorial Lecture. By F. F. Renwick, on "Tonal Reproduction and its Limitations." ("Phot. Journ.," Nov., 1916.)

BUSINESS.

Rights to Photograph.—A case of some considerable importance was heard in the High Court in reference to the acquirement of an alleged sole right to photograph in an exhibition. It was held by Mr. Justice Horridge that in order to make such right a legal one it was necessary for the promoters of the exhibition to grant admittance to members of the public only under a promise not to take photographs. The case is reported in "B.J.," July 14, 1916, p. 397, and is the subject of an article on p. 391 of the same issue.

Eastman Kodak Company.—The annual report for the year ended December 31, 1915, shows a profit of £3,245,660, the largest in the history of the company.—"B.J.," May 19, 1916, p. 294.

Enemy Firms.—The following is a list of firms of enemy nationality in Great Britain which have been the subject of orders by the Board of Trade for the discontinuance of their business:—

A.E.G. Electric Co., Ltd., Caxton House, Westminster, London, S.W.—Electric equipments.

Allolit Co.—Agents for the sale of aluminium foil, 4, Charles Street, Hatton Garden, E.C.

Bayer Co., Ltd., 20, Booth Street, Manchester.—Aniline dyes.

Berger and Wirth (London), Ltd., 76, Finsbury Pavement, London, E.C.—Printing ink and dry colour manufacturers.

Berlin Aniline Co., 30, Princess Street, Manchester.—Aniline dyes.

Busch, Emil, Optical Co., 35, Charles Street, Hatton Garden, London, E.C.—Opticians.

Goerz, C. P., Optical Works, Ltd., 4 and 5, Holborn Circus, London, E.C.—Opticians.

Hanfstaengl, Franz, 16, Pall Mall East, London, S.W.—Fine art publisher.

Hartrodt, A., 9 10, St. Mary-at-Hill, Eastcheap, London, E.C.—Shipping agent.

Meister Lucius and Bruning, Ltd., 20, Princess Street, Manchester.—Dye manufacturers.

Merck, E., 66, Crutched Friars, London, E.C.—Chemical manufacturer.

Metz, Paul, 215, Newhall Street, Birmingham.—Importer of hardware, cutlery, etc.

Reinemann and Co., late 7, New Zealand Avenue, London, E.C.—Dealers in bronze powder, etc.

Rosensteil, Otto, 4, Charles Street, Hatton Garden, E.C.—Paper merchant.

Schoeller, Felix, jun., 55, Conduit Street, London, W.—Importer of photographic paper.

Thospann, A., and Co., 9, Fore Street Avenue, London, E.C.—Dealers in cameras and photographic materials.

Union Electric Co., Ltd., 45-57, Park Street, Southwark, London, S.E.—Electric engineers.—"B.J.," Aug. 25, p. 473; and Nov. 10, 1916, p. 610.

COPYRIGHT

Infringement of Copyright by Living Pictures.—A copyright judgment of some interest was delivered in the High Court on February 29, 1916, by Mr. Justice Coleridge. It concerned the alleged infringement of copyright in a "Punch" cartoon by posed human figures, a form of reproduction which, under the 1911 Act, constitutes infringement. Apparently, from the judgment, it is necessary that the posed group should substantially reproduce the design of the picture in order for it to be an infringement. The judgment may possibly come into prominence again in connection with cinema films having as the basis of their subject some drawing or painting.—"B.J.," March 10, 1916, p. 138.

Right to Negative.—The question whether a photographer who has infringed a sitter's copyright in a portrait by exhibiting an enlargement in his window can be called upon to yield up the negative is the subject of a leading article, in which the provisions of the 1911 Act are considered and the point raised as to whether there is not a legitimate distinction between an original negative and one made for purposes of infringement.—"B.J.," Sept. 8, 1916, p. 491.

WEIGHTS AND MEASURES.

Converting Metric Formulæ to British.—A. Lockett gives the following rule for the conversion of a formula expressed in grammes or c.c.s. per litre into British weights and measures:—Multiply the grammes by 10 and the c.c.s. by 11, and dissolve the quantities so obtained in 23 ozs. of water (or other solvent) instead of the 1,000 c.c.s. of the metric formula. This rule is accurate within less than 1 per cent.

To convert a metric formula of 500 c.c.s. bulk, multiply the grammes by 10 and the c.c.s. by 11, as before, but take only 11.5 ozs. of water or other solvent. For formula of 100 c.c.s. bulk, take 2.3 ozs. of solvent (0.3 oz. is, of course, 144 minims).—"B.J.," October 22, 1915, p. 686.

Home-made Weights and Measures.—Convenient materials for the home manufacture of weights are the various sheet metals, of which the most suitable is lead, and particularly 9-lb. lead—that is metal which weighs 9 lbs. per square foot. A piece 4 ins. square thus weighs 1 lb. and 1 in. square 1 oz. This 9-lb. lead serves very well for the making of odd weights required in particular formulæ. For example, an 800-grain weight is made by calculating the area required—namely 1 5-6 square inches. A piece measuring 1 in. by 1 5-6ths will thus give as nearly as possible the exact weight. For smaller weights sheet lead weighing 1 lb. per square foot is a convenient material, the thinner gauges of lead being readily folded to reduce their bulk, or they can be cut into long strips, rolled up compactly, and the value of the weight and the purpose for which it is to be used marked with paint.

Sheet copper, sold according to the Birmingham wire gauge numbers, is also of service. The numbers indicate the weight of the metal (in ounces) per square foot, common gauges being as follows:—

B. W. G. No.	Ozs. per square foot.
20	26
22	20
24	16
26	12
28	
30	

Weights can also be cut from brass wire or rod sold according to the following average standard weights:—Round brass rod or wire 3-32 ins. in diameter weighs 1 lb. in a length of 36 feet. Therefore, 27 ins. weighs one ounce. If $\frac{1}{8}$ in. diameter, then 15 ins. weighs one ounce. If 3-16 ins. in diameter, 6 ins. weighs one ounce. In square brass rod, one foot of $\frac{1}{8}$ rod weighs one ounce, and other sizes are, of course, of proportionate weights, so that 3 ins. of $\frac{1}{8}$ rod weighs one ounce. Half-inch square rod weighs 1 lb. per foot, and 1 in. square 4 lbs. per foot. It is easy to make exact weights from such materials by cutting a little over the estimated sizes and then adjusting with a file.—“B.J.,” April 28, 1916, p. 247.

II.—APPARATUS AND EQUIPMENT.

(Including Raw Materials Used in Photography.)

The many details of pieces of apparatus published chiefly in patent specifications are not abstracted in this Epitome, as space does not permit of the numerous drawings necessary for their explanation. All patent specifications are abstracted in the "British Journal of Photography," and are entered according to subject and also under the name of the patentees in the index to the yearly volume of that publication, which is issued with the last number of the year or the first of the year following.

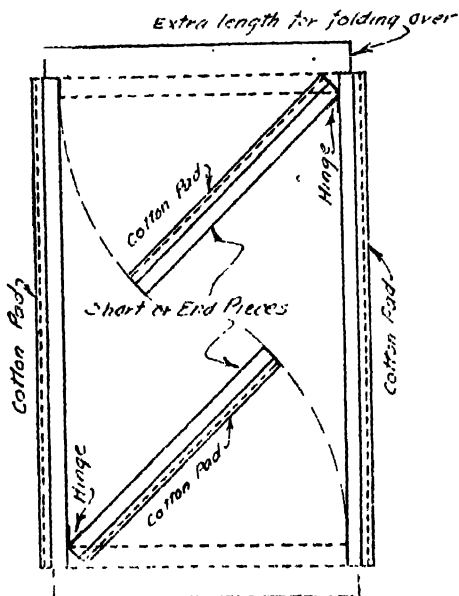
Dark Room and Studio.

Shutter for Dark-room Window.—Leo Kraft describes a ready means of making a light-tight closure for the window in a dark-room, or rather of a room such as a bathroom which is used from time to time for the development of photographic plates. The shutter is flexible, and when not in use can be rolled into a small bundle and readily stored away.

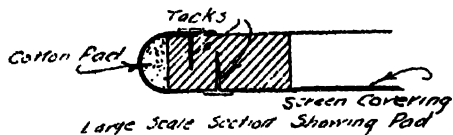
The frame for this screen consists of four boards about $\frac{7}{8}$ in. by 2 ins. and of a length to suit the window the frame is to fit. The two shorter or end boards are hinged to the longer ones, as shown in the sketch, in such a manner that when opened out the four boards form the sides of a rectangle which snugly fits the window. The covering of the screen consists of two thicknesses of black satin with a thickness of black paper between them. This screen covering is tacked to the two longer boards and is left long enough so that it may be rolled around a cotton pad and then tacked again on the opposite side as shown by the large-scale sketch. The covering is not tacked to the two shorter boards, but is left some three or four inches longer than the frame proper at each end, so that when the frame is in use in the window the extra length of covering will fold over the shorter boards. Each of these shorter boards also has a cotton pad on it, the purpose of all of these pads being to allow the frame to be wedged tightly into the window to keep out all light.

To insert the frame in the window, open it out approximately

as shown in the sketch, then place the two longer pieces in the window, after which force the two end pieces into position to complete the rectangle, and this will at the same time compress all the cotton pads to make a tight fit in the window.



This frame has proved entirely satisfactory, and the writer would suggest that the same folding principle might be applied,



with suitable modifications, to backgrounds, reflectors and diffusing screens.—“Amer. Phot.,” November, 1915, p. 664.

Dark-room Illumination by Reflected Light.—Dr. C. E. K. Mees, in commenting upon the small amount of illumination required for comfortable work in a dark-room when the light is directed straight upwards and obtained by reflection from the ceiling, states that he found that a 25-watt lamp covered by a series 1 Wratten Safelight,

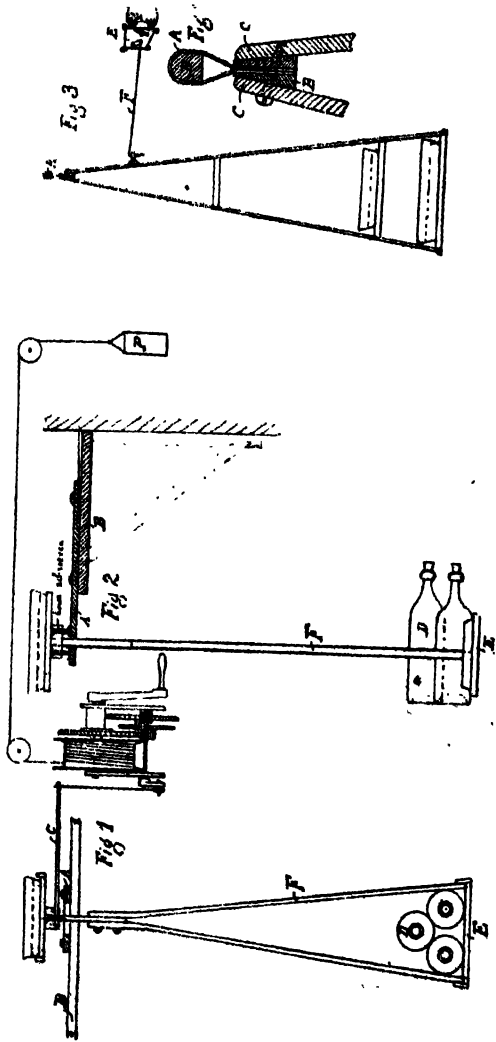
12 in. by 10 in., hung about three feet from the ceiling, gives ample light for every hundred square feet of floor surface. For bromide paper a Series 0 safelight should be used instead, and for gaslight paper a Series 00. For panchromatic plates the same lamp fitted with a Series 3 safelight will give as much light as can be used.—“B.J.,” Oct. 22, 1915, p. 693.

Telling the Right Side of the Film.—An arrangement of the dark-room work-bench which allows of the film side of plates and bromide paper being very readily identified is as follows:—The bench is protected by a low vertical screen from light coming from the safe-lamp several feet away, and is, therefore, virtually in darkness, but over the low screen the light from the lamp can be seen. If a plate is held horizontally just above the screen a reflection of the light can be seen on its surface, and the glass side is at once determined by the clear reflection that it gives. The test only occupies a fraction of a second, therefore no risk is incurred. Bromide paper tested in the same fashion shows a peculiar glitter on the film side that is absent on the paper side, hence the test serves as well for it as for plates. If the lamp does not directly face the bench, a small hole can be made in the side of the lamp and covered with a safelight. Quite a small aperture is sufficient, as all that is required is a beam of light directly facing the eye, and this beam may be as narrow as possible.—“B.J.,” Jan. 21, 1916, p. 34.

Pendulum Plate-Rocker.—A. Kaptyn has described a construction of a pendulum plate-rocker for the dark-room which is more effective but much simpler than that of which details and drawings were given in “B.J.A.,” 1916, p. 425.

Figs. 1 and 2 show a pendulum made of light strips of wood, which any amateur capable of handling a saw and hammer could easily put together in an hour or two. The points which support the pendulum are two stout wood screws resting on two small discs of metal (farthings or halfpennies, which have received on the centre a good blow from a centre punch, will do).

As a weight three pint bottles filled with water are placed on the lower board. E. and the motor is made of an ordinary regulator, such as is found in most arc lamps, many of which are now obsolete and can be bought for a shilling or so. Very little alteration is necessary, and a length of twine led over a couple of small pulleys with a weight of about 2 lbs. (a packet of old negatives) is all that is necessary. This simple apparatus with a whole-plate dish and a pint of developer works very satisfactorily, and if the weight, P, is made to fall 8 or 10 ft. it will rock the dish for about forty-five minutes. Even a 10 by 8 dish with 35 ozs. of developer can be kept going. It may seem surprising that this roughly constructed apparatus with such a small weight as 2 lbs. is capable of keeping a dish of 10 by 8 size with so much liquid in motion for such a long time. Its efficiency, therefore, must be very high, and compares very favourably, indeed, with that of the former apparatus, which kept a 12 by 10 dish and 35 ozs. of developer in steady movement with a weight of 30 lbs. An important matter is that an elastic element



must be placed between the crank and the pendulum. In the previous apparatus an elastic curved connector was used for this purpose. In the present apparatus the same object is attained by a straight connector and coupling it to a thin elastic lath, C, fastened to the oscillating table. This works excellently.

In pursuing this little study somewhat further, a still simpler arrangement was evolved as follows:—For an experiment the dish was removed from the upper table and placed on the lower board, E, in the place of the three bottles, D. Now, when the pendulum is

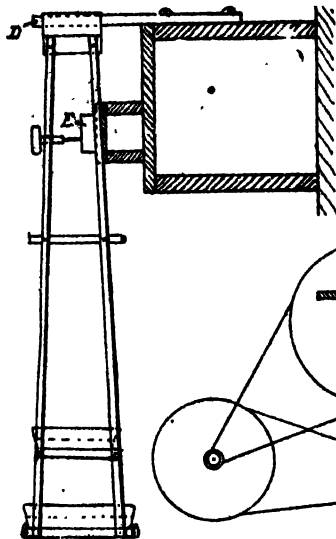


Fig. 4.

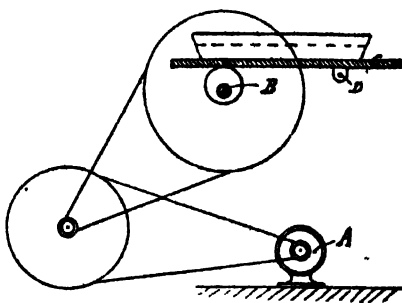


Fig. 6.

swung by itself (without a motor) under these conditions, it will swing for a long time before stopping, and no wave will be originated in the fluid contained in the dish, because the swinging period of the water in the dish is the same as that of the pendulum itself. If, however, the motor is connected to the pendulum it will, at every half-turn of the crank, receive from the motor a push or blow to accelerate and to retard it. This blow will be communicated to the framework of the pendulum, but not to the liquid in the dish, which latter will continue its course, to be finally stopped by the rim of the dish. In other words, without the motor there will be no wave, whereas with the motor a wave will be originated. Transporting the dish from the upper oscillating table to the lower board, E, gave a very good result, and it even appeared as if the weight, P, of 2 lbs. did the work with still greater ease. But if

there is no need for the upper table, then the pendulum can be much simplified, as shown in Figs. 3, 4, 5. Here the pendulum is made of four thin laths and a small board, C, at the bottom, and is of the utmost primitive simplicity.

At the top, Fig. 5, a loop of cloth, A, or strong linen is clamped between two strips of wood, B, and the tops of the laths are nailed or screwed on to the same. This loop is hung over a rod nailed on to one of the shelves of the dark-room. The motor of Figs. 1 and 2 can be used if desired, or a spring motor, as sketched in Fig. 3, will do equally well. In fact, any old alarm clock can be used by removing all the wheels except the spring-drum and the next two spindles. The last of these must be lengthened a little, so as to be able to put a small crank on it and connecting it as shown.

On trial it was found that this construction works very economically, and can easily rock a whole plate dish with a pint of liquid and another on the second board, as shown, and keep it rocking for forty minutes.

On the whole, both these apparatus have a high degree of efficiency, considering that they absorb only about 3 kilogram-metres per hour, or 21.7 foot pounds.

Fig. 6 shows an electric rocker worked out by a friend of the author. A is an electric motor of 1-16th h.p. running at 2,000 revolutions per minute. This speed is reduced by pulleys as shown, revolving a shaft, B, fitted with an eccentric. The board, C, on which the dish is placed, is fixed to a shaft, D, which takes an oscillating movement when the shaft, B, revolves. This arrangement works very well, but is far from economical. It absorbs current, it buzzes terribly, it requires attention to keep the belts taut, it uses 5,700 times more foot-pounds than the two contrivances of the author.—"B.J.," March 31, 1916, p. 195.

Blackening Brass.—Dr. S. E. Sheppard, of the Eastman Research Laboratory, has described the following method of blackening brass with an ammonia solution of copper carbonate:—A hot filtered solution of sodium carbonate is added to a hot filtered solution of copper sulphate, and the heavy, dense precipitate of copper carbonate allowed to settle. The liquor is then poured off, stirred up with hot water, the deposit again allowed to settle, and the water poured away, this process being repeated until the wash water is found by test to be free from copper and sulphate. The copper carbonate is then filtered through an aluminium filter dish and dried; it must not be filtered through paper.

The blackening solution is made by dissolving 5 parts of the dry copper carbonate in a mixture of 10 per cent. ammonia solution, 25 parts; water, 100 parts. The right proportion of ammonia is important: too much or too little will prevent a good surface being obtained. Some copper carbonate will remain in suspension in the mixture, but does no harm.

The brass to be blackened is stirred in this solution at a temperature of about 100 deg. F. After blackening, the solution is rinsed off and the brass dried or baked. Some advantage can be gained by

adding substances such as gelatine, fish glue, gums, etc., to the bath, the most satisfactory addition being a small amount of fish-glue; the addition of 3 per cent. (3 parts) of Le Page's Process fish-glue to the above formula is a distinct advantage, and if the brass after treatment is stoved a very good black finish can be obtained. The time of treatment in the bath with or without the fish-glue will be from 15 to 30 minutes to get a satisfactory black deposit.—"B.J.," June 30, 1916, p. 370.

Studio.

Treads for Studio Stairway.—Material found superior to others, as regards quietness, safety, and economy, for the treads on a stairway forming the public approach to the studio, is leather. Strips of the stout kind, about 18 ins. long and a full 3 ins. wide, make good durable treads when fitted and tacked well into position over the linoleum. These strips cost at the local bootmaker 6d. each two or three years ago: they may be more now, but not so much as the brass, brass and rubber, and other kinds would be.

These were first soaked in water to render them pliable, then surface-dried, and curved and pressed into position around the noses of the stairs—on top of the linoleum—so as to tack under and along the top edge, using bootmakers' $\frac{1}{2}$ -in. tangles. This held them well. The greater portion of the strip should, of course, be placed on the top to receive the brunt of wear and protect stair covering. The ordinary wipe down, with an occasional dressing of grease, keeps the leather alive and tough.—"B.J.," Nov. 12, 1915, p. 737.

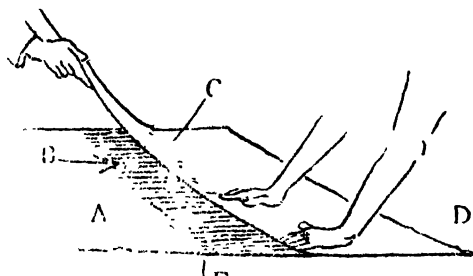
Fireproofing Wood.—"E. J. M." recommends the method of Angus Smith:—Dissolve 1 lb. of sulphate of ammonia (the "brown" kind will do) in a gallon of warm water, and apply warm with a brush. After twelve hours apply another coat. Wood so coated must not be exposed to rain or wet liquid. As the coating raises the grain slightly, planing may possibly be required afterwards. Wood so coated cannot propagate fire.—"B.J.," July 28, 1916, p. 423.

Preserving Cut Flowers in Studio.—According to the "Pharmaceutical Journal," one of latest methods of keeping cut flowers fresh is as follows:—The flowers are first well sprinkled with fresh water and then placed in a vase filled with the following solution:—Hard white soap, 1 oz.; sodium chloride, 50 grs.; water, 34 ozs. The soap is shaved and dissolved in water, and the salt is then added, this causing a slight gelatinisation of the solution. Finally, a very little boric acid is dissolved in the liquid. The flowers are taken out every morning, the foliage washed, and then put back in the vase. The solution is renewed every three days. Flowers thus treated will keep in good condition for two weeks.

Soap Flattening for Backgrounds.—The following is a formula for the preparation of this useful background paint:—Lamp black, white lead, and venetian red ground in as little oil as possible are mixed to the desired shade and diluted to the consistency of

ordinary paint with turpentine. Now shave one ounce of good yellow soap into six ounces of boiling water. When dissolved, bring to the boil and mix with a pound and a half of the paint, stirring until thoroughly incorporated. When cool it is ready for use. This dries quite dead, and will not crack or rub.—"B.J.," Jan. 21, 1916, p. 40.

Repairing Foregrounds.—G. H. Coleman gives the following details for the repair of foregrounds which have become damaged as the result of the trampling by sitters' feet in the studio:—Take the background off the stretcher, and, after transferring the bottom roller to the top, roll the background up, leaving out flat on the floor, face down, the part to be repaired. When the extent of the renewal has been decided upon the foreground is tacked down to the floor, putting in the tacks in a straight line.



A—Back foreground.

B—Glue.

C—New canvas.

D—First row of tacks.

E—Second row of tacks.

Whilst the canvas is kept taut another row of tacks is placed about 18 ins. below the first row. The canvas between the two rows of tacks should not be stretched out of its ordinary dimensions, or kinks will be formed when the tacks are taken out and the foreground again falls into its original position.

The required amount of unbleached calico of the right dimensions is now attached to the old material by means of rubber solution. This first sticking is done with solution because it dries quickly and also because the foreground underneath is not damped in any way, thereby preventing any cockles or kinks when the background is newly hung, and the draw is exercised by the weight of the new canvas. A line of about 2 or 3 ins. in depth of solution should be smeared close up to the first row of tacks, also a similar line on the edge of the new canvas, and the two should not be placed together until they are quite "tacky."

This first bringing together of the new and old materials is the most important part of the whole proceeding. Assistance should be at hand to hold the new canvas squarely over the old, or the two may not eventually hang squarely unless properly brought

together in the first place. The remainder of the sticking down is done with glue (about the consistency of cream) laid on the back of the foreground lying on the floor, and applied with a fairly large brush, not attempting to cover more than the space which is stretched between the two rows of tacks.

It is wise at this stage to get assistance in holding the new canvas out tight while the two are being brought together flatly by pressing and by patting with the palms of the hands, and seeing that they come together smoothly without any creases or air blobs, which is quite an easy matter if someone holds out the new canvas tightly at each end.

As soon as this first portion has been glued together the row of tacks at B should be taken out and put in again, this time tacking the two materials together. Another strip is stretched, tacked down, and glued, repeating the process until the whole of the new canvas is attached to the old.

If the foreground is being repaired only in parts it is preferable to use rubber solution, doing each part separately.

If possible, the whole should now be left in its flat position until dry, but if it *must* be moved it is best to wait until some of the moisture has evaporated and the ground then *tightly* rolled up with newspaper over the painted surface, to prevent any possible injury from the damp glue. It is then left for a day or so to dry. If there happen to be any creases or wrinkles when dry they can easily be removed from the face with a hot iron.

The foreground may now want repainting completely, or it may only want touching where it has worn. The repairs that have been described would remedy any creases or cracks and give extra support to any weak and worn parts; but it often happens that when a background has reached the cracking stage the distemper generally peels off, leaving nasty patches. These may be patched up or the whole foreground may be repainted, which need not be a very skilful performance, as foregrounds, whether indoor or outdoor, are generally plain. The only skill required is the matching of the old colour, and even this is not absolutely necessary; as long as the right tone is reached, it will probably photograph the same in *tone*, if not actually the same in *tint*. If the whole is to be repainted it would be best to stretch the part to be done on the background stretcher.

There are many different compositions with which to repaint, but none better and cheaper can be used than ordinary distemper well sized. The ordinary whitewash so often recommended is wretched stuff to handle, and it is difficult to gauge the necessary amount of size needed. An already sized distemper recommended is "Filocol" (1d. per lb.), 1 lb. of which will cover about six or eight square feet; all that is needed to bring it to a proper consistency is a little water. It should not be made too thin, or it may stir up too much of the old underlying colour. It is perhaps too white for a light background, so a little vegetable black should be added to bring to a cool grey. Before applying to the background a trial should be made on a piece of card, dried to see that it matches fairly the old tone, and rubbed with the palm of the

hand to see that it sets; if not, put in more size (Cannon's Concentrated Size), which has been first dissolved in hot water.

For a dark background the colour should be composed of vegetable or lamp-black rubbed together with a little burnt umber or burnt sienna, according to the old colour, on a piece of glass with a table knife, adding the size gradually.

A mixture of white and black, considerably more black than white, sufficient in tone and quantity, should be made in a pail or pot and "laid on" the background as flat as possible with a white-wash brush. If the background is not a plain one, another lighter tone should be mixed and introduced here and there into the darker one, using the brush in downward dabs, with broad horizontal sweeps here and there to give variety and a feeling, when lying in its original position on the floor, of even ground. But this variety should be hardly perceptible, remembering the important fact that the colour dries up considerably lighter.—"B.J.," July 21, 1916, p. 409.

Lenses and Photographic Optics.

Measuring Focal Length.—Some hints on the advisable precautions in making the measurements for the determination of the focal length of a lens by one or other of the most commonly employed methods are given in an article in the "B.J." The following are those applying to perhaps the best method of measuring focal length—namely, that of Chapman Jones, which is as follows:—

1. Find the infinity mark by focussing on an object at an extreme distance, and marking off somewhere on the camera the extent to which it is racked out.

2. Rack out and focus sharply on a near object of known size.

3. Measure size of image and divide it into that of object, so finding a ratio, which we will call r .

4. Measure additional extension of camera beyond infinity mark, and call this amount x .

Then the focal length is equal to x multiplied by r .

The first of these operations, finding the infinity mark, is not difficult. Using ordinary care in focussing, a good magnifier, and an object a great distance off, only a small error should exist, even if the distance is not strictly infinite. What error may exist is, however, likely to be a *plus* one—that is to say, the infinity mark is likely to be a little too far from the ground glass. This should be borne in mind when taking the measurement in the fourth operation.

Here we want the extra extension for a near object—that is the difference between two extensions, one for infinity, and one for the near object. Therefore, in view of the fact that the marked extension for infinity is likely to be a little too great, we must take special care that the extension for the near object is not too little, and we must also measure the difference rather full. For example, say the extra extension seems to measure as nearly as possible 14½ millimetres. It is better to take it full, and call it 15, than to take it short and call it 14, for the former is more likely to be correct. Remember, however, that 15 is a full measurement.

The third measurement is that of the image only, the size of the object being known. If we use a graduated measure for the object, its size may be taken as exact. Therefore we want to get the image also as exactly as possible. This size has to be divided into the known size of the object, and the result multiplied by x , which we have measured full. Therefore we want a result that is under rather than over the mark, and must measure the size of the image full. Dividing the result into the size of the image, we get r .

The most important measure to get accurately is x , and this depends mainly on accurate focussing. As a rule, this presents little difficulty to an experienced photographer, who is most likely to err in his selection of an object distant enough to serve for an object at infinity. The moon is excellent for the purpose, but in daytime we want a terrestrial object, and it is important to remember that the longer the focal length of the lens the farther away should the object be. For a 5-in. lens an object 200 yards away may be considered far enough, though any greater distance is to be preferred. For an 8-in. lens the object should be at least a quarter of a mile away, and half a mile is better. A 10-in. lens requires an object half a mile away, and a 16-in. lens one at least a mile away. These minimum distances ensure only that the infinity mark is placed within 1-250th of an inch of the right place. This error diminishes inversely as we increase the distance, so that doubling the distance halves the error. It is, therefore, apparent that it is better to take greater distances wherever possible.—"B.J.," February 11, 1916, p. 79.

Hyperfocal Distances.—F. R. Fraprie has published a newly calculated table of hyperfocal distances, its features being the use of different sizes of circles of confusion for lenses of different focal length. The table thus takes into account the different degrees of sharpness required in negatives of different kinds, according to the ultimate use which is to be made of the negative, e.g., contact printing or greater or less enlargement.

The table is calculated from the formula $hf = \frac{F^2}{12 \times A \times u}$ where hf = hyperfocal distance in feet, u = diameter in inches of the circle of confusion or greatest allowable unsharpness of the image of a point, F = the equivalent focal length of the lens in inches, and A = the f number. Such tables are usually calculated for a single circle of confusion (1-100 in.) for all focal lengths, but as the definition required for motion pictures or small negative's for enlargement made with short-focus lenses is much greater than that needed for portraits, the value of u taken for each focal length is given. If the lens is focussed on objects at the distance given in the table, the sharpness will be satisfactory between half that distance and infinity.

It will be seen that the table allows a circle of confusion of 1/400th of an inch for lenses from 2 to 3 ins. focal length; 1/500th for lenses from 3½ to 4½ ins.; 1/250th for lenses from

TABLE OF HYPERFOCAL DISTANCES

 $A = f$ value of lens.

F	Diameter of Circle of Confusion.	A = f value of lens.
2	1.9	2
3	2.2	3
4	2.5	4
5	2.8	5
6	3.2	6
8	3.6	8
10	4.0	10
12	4.5	12
14	5.0	14
16	5.6	16
18	6.3	18
20	7.0	20
22	7.7	22
24	8.5	24
26	9.3	26
28	10.1	28
30	11.0	30
32	11.9	32
34	12.8	34
36	13.8	36
38	14.8	38
40	15.8	40
42	16.9	42
44	18.0	44
46	19.1	46
48	20.3	48
50	21.4	50
52	22.6	52
54	23.8	54
56	25.0	56
58	26.3	58
60	27.6	60
62	28.9	62
64	30.2	64
66	31.6	66
68	33.0	68
70	34.4	70
72	35.9	72
74	37.3	74
76	38.9	76
78	40.4	78
80	41.9	80
82	43.5	82
84	45.0	84
86	46.6	86
88	48.2	88
90	49.8	90
92	51.4	92
94	53.0	94
96	54.7	96
98	56.3	98
100	58.0	100

5 to 7 ins.; and so on, down to 1/75th for lenses from 15 to 24 in. focal length. These standards are evidently very well selected, and the table will be useful to those looking at depth of focus from what may be termed the old point of view. According to the more modern view, depth depends solely on the diameter of the aperture used, and thus a similar result to that in the table is arrived at, the circle of confusion varying inversely with the focal length. The two methods may be compared numerically, taking as the standard allowance of confusion the 1/100th of an inch for a 12-in. lens, as given by the table:—

Focal Length in Inches.	Circle of Confusion.	
	Modern Method.	Mr. Fraprie's Table.
2	$\frac{1}{600}$	$\frac{1}{600}$
3	$\frac{1}{400}$	$\frac{1}{400}$
4	$\frac{1}{300}$	$\frac{1}{300}$
5	$\frac{1}{240}$	$\frac{1}{240}$
6	$\frac{1}{200}$	$\frac{1}{200}$
7	$\frac{1}{170}$	$\frac{1}{200}$
8	$\frac{1}{150}$	$\frac{1}{200}$
9	$\frac{1}{133}$	$\frac{1}{200}$
10	$\frac{1}{120}$	$\frac{1}{150}$
11	$\frac{1}{110}$	$\frac{1}{100}$
12	$\frac{1}{100}$	$\frac{1}{100}$

—"B.J.," December 10, 1915, p. 795.

Workshop Practice in Lens-Making.—H. C. Lord, of the Emerson Macmillin Observatory, Ohio State University, U.S.A., has published particulars of the workshop plant designed by him for the practical instruction of students in lens-grinding and polishing. His monograph is reprinted in "B.J.," Jan. 14, p. 22, and Jan. 21, p. 37, 1916.

Anastigmat Lenses.—A. Knoblauch has patented a type of construction of anastigmat lens, according to which each component of the lens consists of two glasses, the spherical cemented surfaces of which are calculated for the removal of astigmatism, whilst an outer surface of the system is shaped to deviate from the spherical in order to correct spherical aberrations.

The advantages of the system are stated to be particularly apparent in the case in which the system is composed of a biconcave and a biconvex lens, and where the lenses are so arranged in the path of the rays of light that the biconvex lens is remote from the diaphragm and the cemented surfaces act as a converging surface.

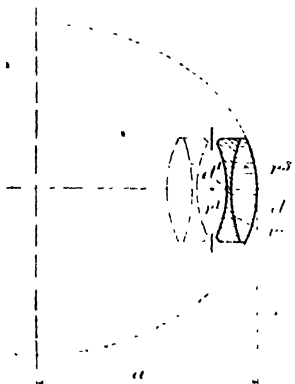
In order to attain in a ready manner as complete a correction of the system as possible, it is desirable also in the improved system

that the two outer faces of the system should possess similar and equally large curvatures.

A photographic objective composed of a biconcave lens with spherical faces on both sides and a biconvex lens cemented thereto, the free outer face of which is constituted by an ellipsoidal surface, has according to this invention the following constants:—

r^1	= -	47.99533
r^2	= +	73.37617
r^3	= -	54.29838
a		95
d^1		2.20
a^2		10.49
n_D		1.52588
n_2		1.53901 (for the biconcave lens)
n_D		1.60980
n_G		1.62293 (for the biconvex lens).

The glasses for the objectives are prepared according to the catalogue of the firm Schott and Genossen, of Jena,



Biconcave lens.—Type O 3422 Melting No. 5687, $v = 51.27$.

Biconvex lens.—Type O 2071 Melting No. 7785, $v = 50.2$.

r^1 , r^2 , denominate the radii of the two spherical faces in millimetres, commencing with that face of the biconcave lens which faces the diaphragm, r^3 is the radius of the deformed face at its apex, a is the semi-diameter of the long axis of the ellipsoidal curvature of the free convex surface in the direction of the optical axis, d^1 , d^2 indicate the axial thickness of the lens, n_D , n_G are the refractive indices of the glasses employed, the distance of the diaphragm from the outer face of the biconcave lens being 6.40 millimetres.

The focal distance is equal to 429.2 millimetres.

The aperture ratio equal 1:10.9.

Such a lens is illustrated in the accompanying drawing in full

lines as a single lens, and with the dotted addition as a symmetrical compound or double lens. The objective may be used in the usual manner both as single objective and as double objective. When the objective is to be used solely as one half of a compound objective, it is not always necessary for all errors to be completely corrected in the one half because the objective may, if desired, be used with a different second half, and the remainder of the error may be completely corrected in a known manner by the second half objective.—Eng. Pat. No. 3,020, 1916.—“B.J.,” March 31, 1916, p. 201.

Cameras and Accessories.

Filling Focussing Scales.—For filling the marks of scales such as those used on hand-cameras, etc., a very suitable material is a mixture of lamp-black and tallow. A little tallow is melted in a small tin or pot and, while fluid, thoroughly mixed with enough lamp-black to make a thick paste. This will set quite stiff, and will keep indefinitely. When required for restoring engraved scales, a little of the mixture is taken on a knife blade or small spatula and spread over the engraving, pressing it well into the cuts. It is then rubbed off with a piece of smooth rag, and the last of the grease finally cleaned off with a wet rag rubbed on a piece of soap. If the engraving is on metal or celluloid no other precaution is required, and if on wood there is no fear of smearing the surface unless the wood is rough and unpolished. A polished surface is quite safe. On vulcanite or blackened metal a white filling is desirable, and this may be prepared in the same way by using whitening, zinc oxide, or plaster of Paris in place of the lamp-black.—“B.J.,” Feb. 11, 1916, p. 78.

Fine Focussing Screen.—H. Stennett describes the following method as affording a focussing screen of particularly fine grain:—A piece of plain glass of the required size is carefully cleaned, and one side is then coated with the ordinary dammar varnish as used for negatives. This varnish is a plain solution of 240 grains of gum dammar in 5 ozs. of benzole, well shaken up, left absolutely undisturbed for two or three weeks to settle, and the clear water-white varnish then decanted to another bottle in which it is kept for use. It is applied cold, and although the surface appears to be dry in a very few seconds, it should be left for an hour or two to get quite hard.

When it has hardened a little very fine pumice powder is put on the varnished surface and gently rubbed in with a tuft of cotton wool. In this way one can gradually give the entire surface of the plate an exceedingly fine grain, making fine focussing very easy. The surface lasts indefinitely. A scratch may disfigure it, but a number of scratches do not interfere with its use.—“Phot.,” May 9, 1916, p. 334

Box for Camera in the Tropics.—W. Maccabe (Brazil) recommends the following method of protecting a camera in severe tropical conditions:—Get a strong tin box, with pull-off lid, the lid rim to

be 3 ins. deep; inside the lid, which must be $\frac{1}{2}$ in. larger than the box, place an indiarubber ring, as in a Griffin's tank; then fasten wood strips in to keep rubber in its place, and to make lid fit. Line the box with felted flannel. To fasten flannel on tin, melt three parts resin, one part beeswax in methylated spirit until thickness of cream. Melt in a hot-water bath. A camera put in a box like this, and lid clamped or strapped down, can be left in a rainstorm for days.—“A.P.,” June 12, 1916, p. 472.

Measurement of Shutter Speeds.—Dr. P. G. Nutting, of the Eastman Research Laboratory, has devised a method of measuring the speed of instantaneous shutters, and at the same time obtaining a record of the efficiency, which consists in analysing the exposure by the aid of light reflected from a revolving crown of mirrors, which can be arranged to give up to 5,000 light-flashes a second. These flashes illuminate the shutter-opening, an image of which is formed by a lens on a strip of cinematograph film fixed on a revolving cylinder. The final result is, therefore, a kind of cinematograph record of the action of the shutter-opening, from which the time and efficiency can readily be calculated.—“B.J.,” July 14, 1916, p. 394.

III.—PHOTOGRAPHING VARIOUS SUBJECTS.

Portraiture.

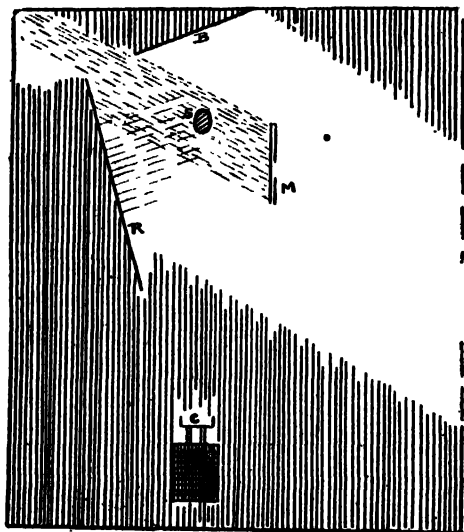
The Portrait Studio.—A lengthy article by "Practicus" deals with the size, design, equipment, and management of the portrait studio, with special reference to the most advisable size of studio and the choice between alternatives of design—e.g., ridge roof, lean-to, single slant, vertical light, and top light. The author considers also the kind and proportion of glazing for the studio, means of covering floors and walls, provision of blinds and curtains, light-controllers and reflectors, and of suitable lenses.—"B.J.," Mar. 31, 1916, p. 183. (The article has since been published in book form, price 6d., by Messrs. Henry Greenwood and Co., Limited.).

Sketch Portraits.—D. Charles summarises the chief points for securing pure white backgrounds in sketch portraits without blocking out the negative, as follows:—1. Suitable background—that is, one with enough blue in it to kill any yellowish tendency in the pigment. 2. Placing the background where it will get as much light as possible and reflect it towards the camera. 3. Lighting every part of the subject so as to obtain it a little lower in tone than the background. 4. Plates (which must be backed), preferably not of ultra speed, in order to secure ample density of the ground. If of ultra speed, the developer should contain double the usual amount of pyro and no bromide, and should be used at a temperature from 65 deg. to 70 deg. For success in sketch work all these points, not merely one or two of them, require full attention.

As regards securing every part of the subject at least a little lower in tone than the background, it is obvious that we must have less light on the subject than on the background. To effect this, all that is required is to flood the background with light, as suggested above, and then to cut some of it off the sitter with one or more muslin screens. How to do this without reducing the light on the background as well is a matter for experiment in each studio, but it is fairly simple if the studio is of a reasonable size and the sitter brought well forward. In the case of artificial-light work, the background must not be too far from the lamp.

The effect of the muslin screen will be to diffuse the light well

over the subject, and give that softness of modelling and gradation so desirable in sketch work. Possibly one thickness may not be enough, and it may be left to individual taste whether the screen should consist of two thicknesses, or whether two screens with a space between should be used; the latter will, of course, give the most diffusion. In some cases a hole in one of the thicknesses may be used to give touches of high-light. In any case, the screen should



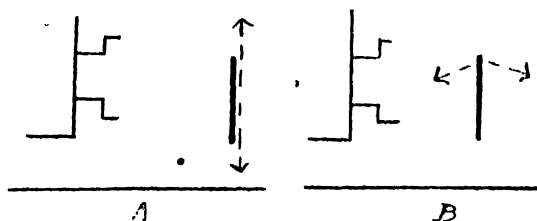
B.—Background. S.—Sitter. M.—Muslin Screen. R.—Reflector. (C.—Camera. Hatched lines represent shaded portions of studio, the clear portion showing illumination from windows, which reaches the background, but is reduced on the sitter by muslin screen, M.

be placed quite near to the sitter. The diffusion of the lighting may be a good deal softer than one would arrange for in the usual way, for the reason that the extra development needed to give over the negative, and this must be allowed for.—“B.J.,” April 21, 1916, p. 239.

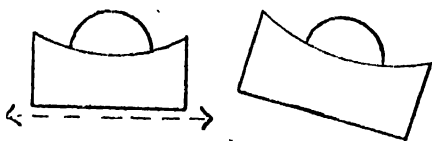
Studio Vignetting.—D. Berlin, in an article on the use and essential features of the camera vignetter, indicates in the following diagrams the chief movements which the vignetter should possess. The vignetting card should be fairly rigidly held at some distance in front of the lens, and should be moved by some convenient method by the operator while under the focussing cloth, so that he can observe the exact effect obtained. It is also obvious that

it should be possible instantly to remove the card when not required, and also to attach other cards of lighter or darker tints to match approximately the depth of various backgrounds.

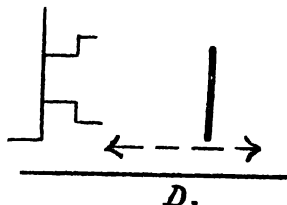
The diagram here shown gives the lens and the card in several positions to show the necessary motions. A shows the movement of



the card vertically up and down to cut off more or less of the subject; B is a swinging movement to and from the lens. The object of this is to render the card lighter or darker in tint. Sloping away, it catches more top light, and, leaning inwards, it naturally becomes



darker in tone. The position of the camera in the studio will, of course, affect the amount of light reflected by this card, so that it will be seen how necessary this movement is. In practice it will be found that three or four vignetting cards of various depths will



suffice with this swinging movement to match any depth of background, from white to almost black. Both these movements A and B must be easily workable from under the focussing cloth. A vignetter that does not allow of this is useless for serious work. This is not to say that other movements need not be workable

from there also. It makes the work much easier if it can be done, but it is not so essential as in the case of the first two. The swinging movement B should be, if possible, pivoted near the top of the card; if near the bottom the swinging will also alter the distance of the top edge from the lens, and so change the degree of diffusion.

Movement C can be either a sliding or a swinging motion across the field of view. This is to provide a sloping edge to the vignette, and the object of this will be seen later. If the movement is a sliding one the edge of the card should be cut to a rather deep arc, in order that one can get the subject cut off by a slanting line instead of a merely horizontal one. This is the movement that is so seldom provided, and is one that will be found surprisingly useful in making the best effects. The absence of this movement can be compensated for in some measure by having a series of cards cut to various angles and curves, but then there is loss of time, and one misses the ability to get the exact adjustments often desired. Movement D is merely for altering the distance between the card and the lens to give various degrees of diffusion to the vignettted edge. Where one lens is used this is seldom needed once the best distance is found, and a foot is about the usual. The adjustment for finding the best distance can be made in various ways by shifting the vignetter or the lens according to the design of the apparatus.

The colour and substance of the cards themselves are matters of some importance, as it is necessary to be able to merge the tint of the card into that of the background imperceptibly, and to depend on getting the effect seen on the focussing screen on the negative. Grey tinted papers so often contain a lot of blue, and sometimes green. This will obviously give results different from those seen. Quite neutral greys should be chosen—in fact, it is far better to make the tints by means of an air-brush, using mixtures of process white and black, which will photograph as seen.

It is possible, and desirable also, when making one's cards in this way to introduce some gradation, as a quite plain tint at the bottom of a picture looks rather bald as a continuation of most backgrounds, and also shows up any imperfection in the negative or paper. In the latter nowadays there are more frequently spots and markings than there were before the war interrupted the supply of pure papers.

Any gradation introduced need not be delicate, as it will be very diffused on the focussing screen. One card can have a light centre for light subjects, and another a dark centre patch for men's coats taken against a light background, and so on. The cards should not be made out of any old mount, as is so often done. The edges, which are usually slightly serrated (though this is really not necessary), soon break when pulpy boards are used, and any spots of the white middle will produce a slight, but objectionable, disc of light on the picture. Two thicknesses of a good quality "art board" stuck together or a stiff millboard are good wearing substances, and have no white middles to show. In any case the cut edges should be blackened, whatever the tint, as these are more liable to catch more light than the surface of the card. Of course, every card can have each side different; this idea will just halve the number of

cards, and a convenient shelf or rack ought to be provided in the studio to hold those not in use, where they will not get dirty and broken.

In the case of sketch pictures taken against a white ground, an ordinary white card is useless unless further vignetting in the printing-room is expected. Nowhere near as much light will reach the card as is reflected from the background, and the former will consequently photograph as a grey in comparison. The way out of this difficulty is to use a substance that is semi-transparent. Ground-glass has been tried, but the edge prevents satisfactory diffusion of the subject into the ground, a well-defined band of grey being produced between the two. Tissue-paper with a cardboard margin or frame at the bottom and sides for stiffness is good, but needs continual renewal. A material which answers well is white buckram, obtainable at a milliner's or draper's at sixpence per yard. This is like cheesecloth, but is very stiff and tough. It needs a card frame just as the tissue-paper to keep it flat, but it will not tear, and if a serrated edge is desired the points will not droop.

Generally, to get a good white it is necessary to have the vignetter sloping out away from the lens as far as possible. There is one unfortunate point in making sketch vignettes in the camera, and that is when photographing dark subjects there is apt to be a distinct band of a still darker tint about a quarter of an inch broad just above where the diffusion commences. This naturally spoils the gradation, and it can be seen, if looked for, on the focussing-screen. This defect can be minimised, and often entirely avoided, by blackening the edge of the vignetter itself at the centre, and roughly graduating this black into the white. This is conveniently done by cross-hatching with a crayon. Thus the edge of the white vignetter is not so sudden, and distinct bands of diffusion are avoided.

Too much reliance should not be placed on the movements for obtaining effects; they should be regarded rather as fine adjustments only for the generality of work—that is to say, for example, that a dark card should not be swung out far to get a light effect. A card that matches the depth of the background with the apparatus in a normal position should generally be used, and strain and wear avoided. A vignetter that is constantly overstrained will soon develop “backlash” and other annoying symptoms in its various parts, and, worst of all, cannot always be depended upon to stay as it is put when one's back is turned on it for an instant. It will be found that raising and lowering the camera will alter the vignetting effect, so it is better to compose the picture first of all, then adjust the vignetter to the required slant. Next swing it to get the tint to match the background, and then raise it to the exact height required, focussing accurately last of all. This order of operations will be found generally most convenient. A few notes as to the movement C will complete all that can be usefully said on this subject. As stated already, this is not often provided, but can sometimes be arranged fairly satisfactorily on existing apparatus either by a series of variously shaped cards or by a system of clips. Where this movement is not built in it is not easy to provide for

working it while observing the image, and this is a very great disadvantage. It is just this movement in a vignetter that will make the difference between its being merely an instrument for cutting off waistbelts, etc., and becoming adaptable for all kinds of effects.—“B.J.,” Feb. 4, 1916, p. 67.

Camera Vignetter.—D. Berlin, in reference to the above, has described how to make a vignetter for studio use, operated in all its movements by one handle behind the camera. The materials required are as follows:—Two quarter-inch bolts, one about three inches long, and the other one inch long with wing nuts, and two straight lengths of $\frac{3}{8}$ -in. iron rod, each about a yard long. These should be brassed or nickelled, if obtainable; but if not, a very good finish can be obtained on iron rod by the use of emery cloth, first coarse and then fine, afterwards lacquering with celluloid varnish, or even with ordinary negative varnish, applied to the warmed rods. The remaining materials are chiefly bits of wood and brass strip (old printing-frame springs), etc., which will scarcely have to be bought.

One of the rods is bent at one end into a ring or triangle to form a handle (A, Fig. 1), the other end is merely bent at right-angles about two inches up. This rod should be as straight as possible, but the other one does not matter so much except for about six inches forming the straight end, B. This rod is bent so that from the line where it is held under the camera, C, it drops two inches and is bent outwards four inches also. The 6-in. portion, B, is then bent at a right-angle at D, and should now be horizontal and at right-angles with its original direction, but somewhat below also. Also, if the line C were produced it ought to cross B fairly centrally. The end of this rod at C is filed square so that it can be clipped firmly to prevent the B portion from moving out of the horizontal when the parts are assembled and in use.

E is a disc cut out of three-ply wood. This forms the base of the instrument, and is screwed in a vertical position to the middle of the camera. Some stands will require a wooden block as a support for this disc, which is 4 ins. in diameter. F is a piece of half-inch wood which is grooved to take the rods. The groove for the top rod A is merely a shallow cut made with a tenon-saw so that the rod will lie in it only half its thickness. The lower groove is cut square to take the squared end of the lower rod and needs to be as tight a fit as possible. G is a piece of strong brass spring about an inch wide, with its ends bent up slightly and a V-cut made with a file on each projection to correspond with the top groove in F. This will furnish a sliding movement for the top rod while holding the lower one firmly. G may be made of a strip of hardwood if desired, in which case a spring outside it should be provided to allow of the rod sliding smoothly, but also being held without slipping. E, F, and G have each a $\frac{1}{4}$ -in. hole through the centre to take the 3-in. bolt before mentioned; the wing-nut permits, with the brass spring, of adjusting the grip

on the sliding rod, as well as of the up-and down movement which is provided by revolving the whole thing on the disc E with the bolt as a pivot. Friction alone is generally sufficient to keep this from moving when not required, but if the parts should wear too smooth a bit of leather or an additional piece of brass spring between E and F will prove effective.

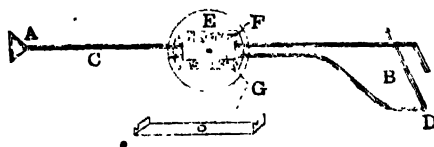
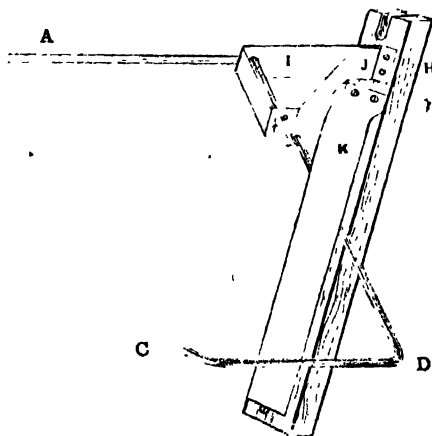


Fig. 1.

The remaining parts require to be carefully made so as to prevent backlash and ensure smoothness and freedom in working, but there is no particular difficulty, and there is no need to adhere very closely to the measurements given. If (Fig. 2) is a strip of wood about $\frac{1}{2}$ -in. thick, 8 ins. long, and $1\frac{1}{2}$ in. wide. A $\frac{1}{4}$ -in. wide slot is cut down through the top about $\frac{1}{2}$ in. down. I is a



strip of brass about $\frac{1}{2}$ in. wide and 6 ins. long, bent into a kind of loop, of which one side is straight. Two holes are bored to take the bent end of the rod A, which is then fitted with a cotter-pin or other means to prevent the rod from slipping out of the holes. The ends of this strip I are brought together at J, and are then riveted to one side of a hinge as shown, the other

half of the hinge being firmly screwed to H. Another strip of brass, K, one as straight as possible, and at least an inch wide, is bent at one end and screwed to H, as shown, so that it stands away from the wood just a quarter of an inch, a screw under the opposite end keeping it away just that amount and giving a means of adjusting the distance to a nicety. This is intended to provide a slot to work over the end of the lower rod B.

When these parts are assembled and adjusted to work smoothly it will be found that by raising and lowering the handle A, the wooden strip H (which holds the vignetting card in a manner about to be described) obviously will also move up and down by reason of the pivot in the centre of the apparatus, and the spring should hold it at any position. By pulling or pushing A, H will be swung backwards or forwards, B providing a fulcrum, while twisting the handle will swing H to either side. Here again B, working in the slot between H and K, will keep the latter from twisting about, so that the card will always have its edge parallel with the camera front. These directions may not be quite evident from the description until the apparatus is put together, when they will become obvious.

The only remaining feature is the vignetting card itself. This is simplified considerably by making it in the form of a large triangle, of which one side is made of buckram and the other sides of differing tints of grey paper pasted on to the card base. Each edge is cut slightly hollow, of course, but is not serrated, and the corners are rounded, thus giving somewhat the shape of a propeller. The centre is strengthened with a piece of thicker card and a hole is punched in the middle to take the short bolt. To attach the vignetting card it only needs that the bolt be slipped into the slot at the top of H, and a turn of the wing nut will secure it. In cases where considerable slant of the vignetter is required to one side or the other it is generally more convenient to swing the card itself before screwing up, and rely on the apparatus for the fine adjustment. There is no reason why the ordinary cards should not be used, but the propeller form gives several cards in one piece, any one of which can be instantly brought into use.

The only matter which requires further explanation is that where the instrument cannot be fixed centrally under the camera it is necessary to screw a strip to H, which will carry the vignetting card over to the centre. In this case the twisting of the handle will raise or lower the card slightly as well as swing it round; but if the card is adjusted approximately first of all, as suggested above, this drawback will be practically negligible.—“B.J.,” Sept. 29, 1916, p. 528.

Portraiture with Open Arc Light.—G. R. Henderson has also described the handling in the studio of the multi-carbon open arc lamp such as the “Northlight” of Messrs. Marion. While recommending the regular mode of employing this lamp, namely, with an umbrella reflector, he describes other arrangements for use as occasions require.

For Rembrandt and such lightings it will be better to use a large reflector on the shadow side of the sitter. This should be kept at a respectful distance from the lamp and sitter—otherwise

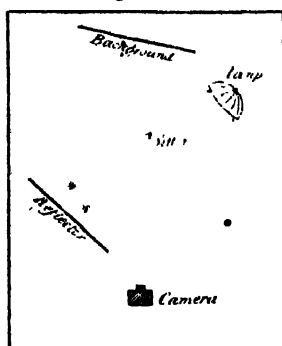


Fig. 1.

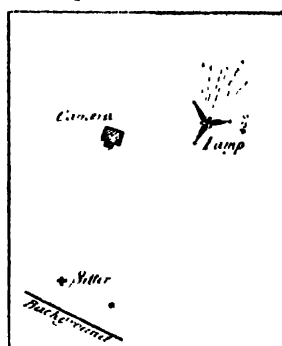


Fig. 3.

cross lighting and troublesome reflections are bound to occur. Fig. 1 shows the arrangement of lamp, reflector, and sitter for a Rembrandt effect. When used for high-class work in the studio it is better to

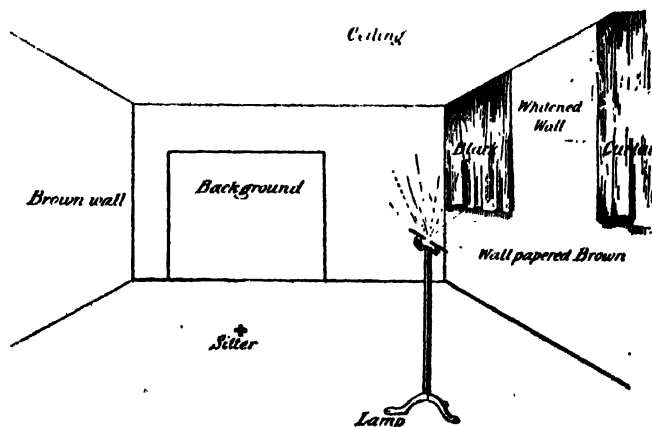


Fig. 2.

do without the reflector altogether, the lamp being used as hereafter described.

We will suppose that the studio is to be run entirely by artificial

light, and consists of a room from 25 ft. to 30 ft. long by about 16 ft. wide, and the ceiling 9 ft. 6 ins. to 10 ft. 6 ins. from the floor. The wall on one side of the room should be papered white, beginning at 4 ft. 6 ins. from the floor. This should be given two or three coats of white distemper, so that a good matt white is obtained. The ceiling should also be distempered. The wall and ceiling forming a continuous white space, we may suppose it to be the ordinary side and top light of a daylight studio. The lamp is now placed so that it is facing the wall and the crater tilted so that the whole of the light is thrown into the corner where wall and ceiling meet. If the umbrella were fixed to the lamp it would be found that a large amount of light would be kept from the sitter, but the silvered crater of the lamp is quite sufficient to reflect the light on to the wall and at the same time is too small to interfere with the lighting of the sitter. The whole of the wall and ceiling will be illuminated, and it follows that this lighting area will have to be controlled with blinds, etc. Curtains should be hung on wires stretched along the wall. It is not necessary to have blinds on the ceiling, as a head screen will do all that is required in this direction. Any part of the wall may be covered as may be found necessary. Fig. 2 shows the arrangement of lamp, etc., for normal lighting.

Any effect may be obtained—from "Rembrandt" to "top" lighting. The lamp may be moved from one end of the studio to the other, and right or left lighting obtained as desired. The light may be thrown on to the ceiling and a large group evenly illuminated by top lighting. The sitter may be placed in any part of the studio and the exposure be lengthened only very slightly. Exposures range from 1.5th sec. to $\frac{1}{2}$ sec., according to position and lighting of the sitter. Side screens and head screens may be used exactly as in a daylight studio. Low-toned effects are got by placing the sitter in a far corner of the room and the lighting arranged as for normal lighting. Fig. 3 shows this arrangement. This is a favourite lighting with the writer, as the pictures when printed in sepia platinotype resemble a first-class photogravure. A three- or four-pair arc lamp will be found best for a room of this size, although a two-pair lamp could be used and good results obtained if the sitter were kept nearer the light and only small groups attempted. If the lamp has to be used in an ordinary studio it is a good plan to have the dark blinds next to the glass, and under these a second set of blinds made of white nainsook. When daylight is done all the blinds are drawn and the lamplight thrown on to the white blinds, which serve the purpose of wall and ceiling as mentioned above. Owing to the large area of light, it is absolutely necessary to have the lens shielded, otherwise fogging is sure to occur. A good plan is to have a large canopy fitted to the studio stand, so that the whole thing keeps in place and moves about with the camera. This large canopy also allows the operator to change lenses and alter lens stops without difficulty. After the first fitting it should require no further attention, except brushing occasionally to keep it clean and free from dust. The light will be found a very actinic one, and plates of ordinary speed may be used and rapid exposures given.—"B.J." Jan. 28, 1916, p. 53.

Portraiture with Enclosed Arc.—G. R. Henderson describes an arrangement for studio portraiture with one enclosed arc lamp, such as the "Westminster," which is different from that usually adopted, inasmuch as the light from the arc is obtained entirely by reflection from an inclined screen as shown in Fig. 1, where the black disc represents the position of the sitter. The installation should preferably be placed on the solid (unglazed) side of the studio.

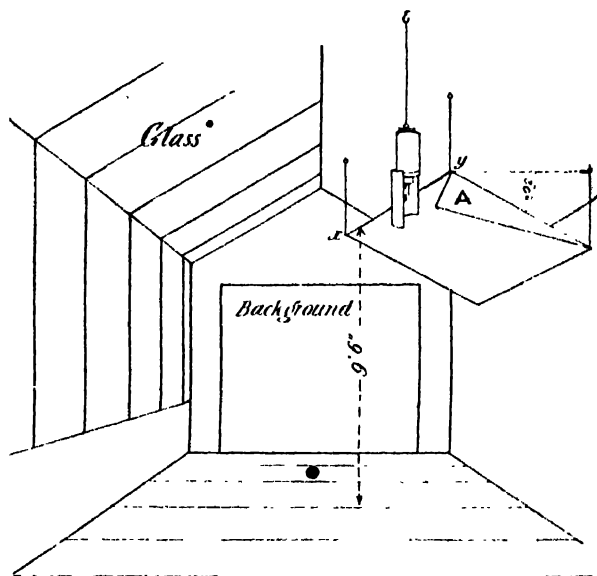


Fig. 1.

The reflector is made in two parts, viz., one frame 5 ft. by 6 ft. and one frame made in the shape of a set square, the long side being 5 ft. and the short side 1 ft. 6 ins. The frames are made of wood $2\frac{1}{4}$ ins. wide and 1 in. thick. Both are covered with sheeting and coated with white distemper on one side. Fig. 2 will make this clear, and will also show how the frame should be put together, the edge A-B of the smaller frame being screwed to the edge C-D of the larger one. The receptionist or other assistant should stand in the place usually occupied by the sitter, generally 3 ft. from the background. The light should then be arranged to fall on to the sitter at an angle of 45° . The end of the reflector, marked A, should be 9 ft. 6 ins. from the background, and the edge X-Y 9 ft. 6 ins. from the floor, the reflector being inclined to the floor at an angle of 30° .

The next consideration is the position and preparation of the lamp. The "Westminster" arc lamp may be taken as a standard pattern: A 15-amp. lamp will be found most useful. A metal reflector should be fitted. These are obtainable from the manufacturer, and should be ordered with the rest of the fitment. The lamp is suspended from the roof so that the arc is about 1 ft. below the edge X-Y of the reflector, and about 2 ft. from A. The light must be thrown towards the corner of the reflector, and no direct light from the lamp allowed to reach the sitter. Fig. 1 shows this arrangement of lamp, sitter, etc., in position, the place of the sitter being as shown as ● ■

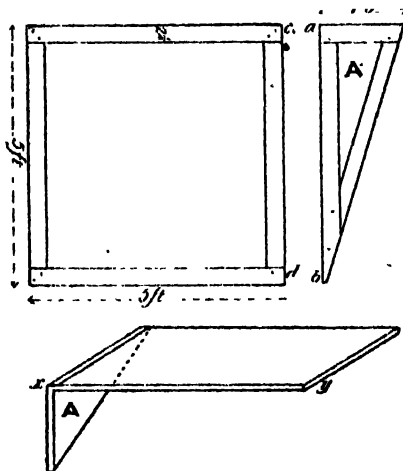


Fig. 2.

The resulting lighting is excellent, the lighting on a full-length figure being very even from head to feet. The modelling leaves nothing to be desired, softness and brilliancy being well combined. The sitter may, of course, be moved about if a varied lighting is required, and almost any effect can be got without undue loss of time or lengthy exposure. The lighting is nicely rounded, yet sufficiently brilliant for general purposes. The lamp need never be moved when once fixed. The average exposure is about one second, and results may be considered equal to daylight.—"B.J.," Dec. 31, 1915, p. 851.

Cleaning Enclosed-Arc Glass Cylinders.—The yellow deposit which forms on the glass cylinders of enclosed arc lamps can be largely removed with methylated spirit. But in order to get the glass perfectly clear it is usually necessary to swab the surface with dilute hydrofluoric acid. The acid must be kept in a gutta-percha bottle, and applied with a bit of sponge attached to a short

stick, the greatest care being taken to avoid contact with the skin — "B.J.," Feb. 11, 1916, p. 78.

Live Portraits.—A. S. Spiegel, R. Glendenning, and G. Felsen-thal have patented a method of producing "live" photographs, that is to say prints from a composite negative recording two or three different phases of movement. The method consists in making several successive exposures with a line screen placed in front of and in contact with the plate, the plate (or screen) being moved between each successive exposure so that the subject is recorded in bands distributed in alternation over the negative. For three exposures the width of each line in the screen requires, of course, to be double that of the intermediate spaces: for four exposures, the bands require to be three times the width of the spaces. From the negatives so produced ordinary prints are made and are mounted in contact with a similarly ruled screen (celluloid) over the face of the print and affixed to the mount in such a way that it can be given a slight shift, the lines of the screen remaining parallel with those of the print. In this way one or other of the successive exposures is presented to view and the effect of a moving portrait produced. The patentees describe the apparatus for exposing the plate in successive steps behind the screen, and also specify a form of mount suitable for the movement of the viewing screen in relation to the print. Eng. Pat. No. 5226, 1915. — "B.J.," June 16, 1916, p. 349.

(The process described in the above specification is practically identical with that described by R. R. Beard in a now expired patent, No. 22,361, of 1898. A somewhat similar process, although for a different object, was patented by Brasseur and Sampolo, and is described in the "British Journal" of April 2, 1897. Brasseur and Sampolo used a ruled screen in front of a plate, and made exposures on the same subject at three successive positions of the screen for the purpose of obtaining in a single negative banded records of the green, blue-violet, and red in the subject, obtaining these different records by means of light-filters on the lens.—Ed. "B.J.A.")

Living Portrait Photographs.—A writer in the "Photo Revue" describes the apparatus available for use and the principle adopted in the making of these photographs.

The new form of portrait results from a positive print, the image of which consists really of several distinct images formed as narrow bands and occurring in a regular sequence across the print. The negative is obtained by posing the sitter before a camera, the sensitive plate in which is exposed through a ruled screen. The opaque lines of this screen have a width which is equal to that of the clear space between the lines, or is twice or thrice the width of the clear space. Reference to Figs. 1 and 2, which show, respectively, the back and front of the rear part of the camera, will make clear the mechanical device by which the three exposures are produced in this way on a single plate. There is nothing special about the plate: those used in ordinary photography serve perfectly in the process.

Imagine that we have a lined-screen, the lines, or bars, of which are three times the width of the spaces between, for example, lines of $\frac{3}{10}$ ths of a millimetre in width and spaces $\frac{1}{10}$ th of a milli-

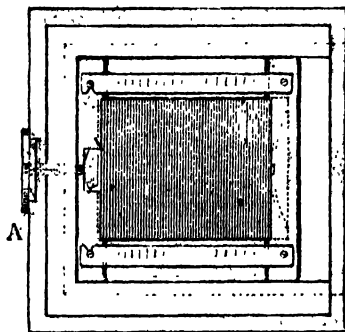


Fig. 1.—Front view of the dark slide. Plate is behind the screen.

metre wide. Figure 3, then, illustrates the distribution of the four successive exposures; it shows how each of four different phases of the sitter is distributed in narrow bands over the area of the negative.

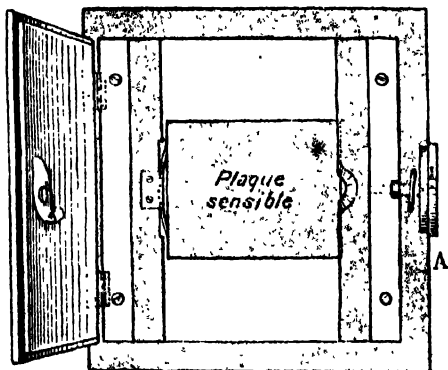


Fig. 2.—Back view of the apparatus. The screen is in front of the plate.

After the first exposure the screen is shifted by means of a micro-metric screw through a distance equal to the width of the clear spaces. Thus the opaque lines of the screen cover all the narrow

bands on the plate which have just been exposed, and uncover immediately adjacent to each of these bands a new narrow strip on which the second exposure is made. This second phase of the sitter having thus been recorded, the operation is repeated for a third or, possibly, for a fourth time. It will thus be seen that the number of possible exposures is conditioned by the width of the bands in reference to that of the interspaces. In the example illustrated the band is supposed to be four times the width of the interspace.

On now making an ordinary print from the negative so produced and laying upon it a screen of ruling identical with that employed in the making of the negative, it will be clear that the screen can be so placed upon the print as to show one or other of the four sets

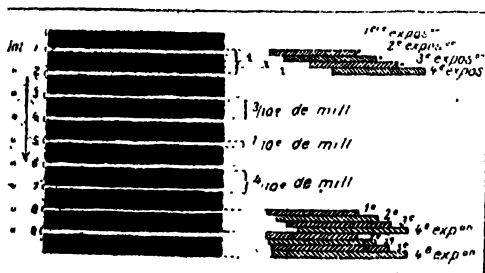


Fig. 3.—Diagram showing the four successive exposures in bands by minute shifts of the screen.

of image bands. If it is placed so as to render visible the bands representing the first exposure, a slight shift will uncover in succession the second, third, and fourth series of bands with a rapidity sufficient to give the illusion of life. This lateral shift of the viewing screen in relation to the print may be done by means of a special form of mount or by the imperceptible sliding movement (to the extent of about half a millimetre) which is produced by bending the frame mount in which the print is held, the print being fixed at one end of the mount, the viewing screen being fixed at the other, and the opposite extremity of each being free.

Already a number of studios in Paris have taken up this new form of photography. The special apparatus is by no means complicated. It consists essentially of a special form of carrier contained in the dark slide and allowing of the plate being given a definite and minute shift by means of an external micrometric screw, A. (Fig. 1.) The ruled screen is mounted immediately in front, in contact with the plate (Fig. 2). A device of this kind can be fitted without difficulty to the ordinary models of studio camera, and the expense of making this modification will be quickly repaid in the business obtained for these living portraits, which have proved themselves to be highly popular with the public.--"B.J.," Sept. 15, 1916, p. 503.

S. J. Gannat has patented a special form of photograph, namely, one intended to produce an effect of life or movement as the eye is moved in relation to it. In photographing the subject, two or more exposures are made on the same plate through a ruled screen placed immediately in front of the plate and moved the distance of the width of one of its clear bands between each exposure. The print from the negative is mounted behind a similar screen placed a certain distance in front of the print. On viewing the photograph from three slightly different points the effect of movement is obtained.—Eng. Pat., No. 5,961, 1915. "B.J.," Sept. 22, 1916, p. 521.

Flashlight:

Electric Flashlight Ignition.—W. Caudery uses for the purpose of electrically igniting the flash powder ordinary house current on the principle of leading the current through a leaden fuse of considerably less resistance than the fuses of the house supply, and thus producing a short-circuit in contact with the powder. With a supply pressure of 110 volts, a fuse of diameter $\frac{3}{10}$ ths of a millimetre ($.012$ of an inch) was found efficient, and would doubtless be so at higher voltages.

The ignition apparatus consists of a piece of hard wood 5 by 3 inches, and $\frac{1}{2}$ in. in thickness, into which are screwed two brass screw-eyes of such length as to pass right through the wood,

leaving about $\frac{3}{16}$ ths in. of the threaded end projecting on the other side; this side is the top of the ignition tray, and the screw-eyes should be set 1 in. apart and across the width, in such a way that when the powder is placed on the tray it may be laid in a long ridge, the fuse passing through it transversely.

The leaden fuse is stretched from point to threaded point of the screw-eyes, a round turn at each point being sufficient to hold it in position, and the final connections are joined up on the underside, as described below. Exposures of from 15 to 20 grains each can be made with nothing but the plain wood to serve as a tray, with no worse result than a slight charring, but for those who may find it necessary to use more powder or prefer to be on the safe side, a mixture of finely-ground pumice powder and "Secotine," worked up to a thick cream with a palette knife on a piece of

glass, and laid on in a smooth even coat, forms, when thoroughly dry, a very effective protection for the wood, which it is for obvious reasons necessary to use.

For the wiring all that is needed is seven or eight yards of flexible wire suitable for lighting. Take a yard and a half of this and cutting one strand of the long remaining piece at one-third of its length from the end, join the shorter length to it by interweaving the copper wires, one strand of the shorter length to each severed end of the cut strand of the longer, taking good care to insulate each joint separately with rubber-coated tape made for this purpose.

The wire thus remains as in the sketch, J J being the joints in the wire; these wires are, of course, twisted together in the usual manner, but are here sketched side by side for the sake of clearness.

This completes the wiring. The end A, being destined to join up with the ignition tray, is fitted with the forked contact of a wall plug; the end B should be fitted with a bayonet plug to fit any lamp-socket, and C is joined to a pear-shaped bell switch, a slight pressure on which will be enough to light the powder from any part of the room, according to the length of flexible wire from J to C.

A bell push is chosen for preference because, as the current should be turned into the wires at the room switch, and contact is only made at the moment of pressure, with a bell push the worker can be sure that there will be no current at the terminals when renewing the fuse. There is no risk of an arc forming in the bell push, since contact is broken as soon as made by the fusion of the lead. A hard nailbrush should be kept, and the terminals smartly brushed after each exposure to remove any agglomeration of oxide which might prevent firing of the charge by partially insulating the fuse from the terminals.—"A.P.," Feb. 21, 1916, p. 145.

For the same purpose J. Graham recommends electric ignition as quite the best for flash powder. If a wooden tray is used for the flash powder, a couple of ordinary brass bolts can be fixed in it about an inch or less apart, and a length of flexible cord taken down to the battery switch. Then all that is necessary is to clamp a piece of "one amp" fuse wire across the bolts before spreading the flash powder. Should the fuse wire be unobtainable, the very finest iron or copper wire should be used. It is a wise plan to cover the fuse wire with a small piece of pyroxylin or gun cotton, otherwise the metallic flash powder has a tendency to adhere to the fuse and cause a sort of short circuit, which will prevent the fuse getting hot enough to fire the charge.

The batteries used are preferably ordinary motor ignition accumulators of 4 volts and 10 to 20 amps capacity. Hellsen ignition dry batteries may also be used, these costing six or seven shillings, and lasting six months or longer. Leclanché batteries can be used by those who do not mind the weight and cumbersomeness.—"B.J.," Jan. 7, 1916, p. 14.

Flashlight ignition by means of a torch is a method recommended by Messrs. Bunce Brothers, Caterham, who describe it as follows:—Take a round stick, such as are used for window-curtains, about $\frac{1}{2}$ in. thick, say 4 ft. long, and put on the end a ferrule of brass tube, say 4 ins. long, leaving about 2 ins. protruding. Into this tuck a short length of ordinary cotton-wool for a wick. Carry a small bottle of methylated spirit in the kit (a 1 oz. chemical bottle answers well), and when ready to ignite dip the wick in spirit, apply a match, and you have a very practical torch, safe, certain, and with a very hot flame, which cannot fail to ignite the powder immediately. For a powder pedestal of this kind one may use an old tripod with fixed top, to which is affixed an ordinary tin lid. These arrangements, though simple, have proved very practical in working.—“B.J.,” Jan. 14, 1916, p. 30. •

Gun-cotton for Flashlight Ignition.—There are two distinct kinds of gun-cotton obtainable quite readily. The ordinary “low temperature” kind, as used for making collodion, is sold at about a shilling an ounce, and is generally kept (for safety) soaking in spirit. It should be dry before use, and is suitable for the kind of flash-lamp in which a gas flame explodes the powder. A little bit of the cotton is fluffed out and laid on the powder where the flame will meet it.

The other kind is called “high temperature,” and must not be soaked in spirit, but can be kept loose in a box or tin. This variety costs about 3s. 6d. per ounce, but a very little goes a very long way, and a quarter of an ounce will last a long time. The special quality possessed by this kind that appeals to flashlight workers is the speed with which it burns up immediately it is fired. It is very fast as compared with the “low temperature,” and disappears in one flash. This will be found most suitable for lamps in which a sparking arrangement or a red-hot wire is the ignition.

A bit of the cotton (a loosely pulled out bit is always best) is laid over the fuse quite loosely and the powder over that. The only exception to this method is the “Snaplight” lamp, in which the red-hot point is moved through the heap of powder. In this lamp it is best to drop the gun-cotton, so that the red-hot arm meets the powder first and then pierces the cotton underneath.—“B.J.” Sept. 8, 1916, p. 495.

Copying.

Copying Line Subjects.—John H. Gear has given the following hints on copying line subjects on dry plates:—The lens should be of much longer focus than one would use to cover the plate in ordinary work, and should preferably be used with a small stop— $f/45$ or $f/64$ —in order to secure the finest definition. A slow fine-grain plate should be used, such as a process plate or a slow lantern plate. Mr. Gear has found specially serviceable the Imperial “Special” lantern plate, obtaining ample opacity and extreme cleanness of the lines. The plate should be hacked.

A suitable developer is:—

A.—Hydroquinone	1 oz.
Potassium metabisulphite	1 oz.
Potassium bromide	1 oz.
Water	to 20 ozs.
B.—Caustic potash	2 ozs.
Water	to 20 ozs.

Equal parts of A. and B. and 2 parts of water are mixed to form the developer, which should be used not lower in temperature than 55 degs. F. The plate should be washed much longer than usual after development and before fixing, in order to avoid opalescence in the film.

Fixing is a most important part of the process. A full-strength hypo bath should be used, and the plate rocked the whole of the time it is in it. It should then be washed for at least ten minutes under the tap, the water running straight upon it, and is then ready for reduction, for the purpose of clearing away any deposit on the lines.

For line subjects the reducer is made up by dissolving 5 ozs. of hypo in 20 ozs. of water, together with 3 or 4 grs. of potass. bromide. To sufficient of this mixture a little freshly made solution of potassium ferricyanide is added until the mixture is a deep orange colour. The colour is best judged by daylight. This reducing bath acts strongly on the lines, "cutting" them clear, whilst also reducing the depth of the ground to a considerable extent. It is, however, necessary to use it in order to get the lines clear: the opacity of the ground is restored by intensification.

After reduction, the negative should be washed in running water for at least 15 minutes, and is then ready for intensification, the first operation in which is to bleach the film thoroughly with the following:—

Mercuric chloride	100 grs.
Potassium bromide	100 grs.
Water	to 20 ozs.

The film is bleached right through to the side next the glass, and then it must be washed. Immediately it is placed under the tap the surface of the film should be wiped over with a pad of cotton-wool to remove any free mercury which may be left upon the film surface. It should be washed under the tap for another 15 minutes, and then to darken the negative a silver-cyanide solution is used.

To make the silver cyanide, take 5 ozs. of distilled water, in which dissolve 100 grs. of nitrate of silver. Then take a second 5 ozs. of distilled water, and dissolve in it 80 grs. of cyanide of potassium. This second 5 ozs. is put into a 10-oz. bottle, and by adding the silver solution slowly to the solution in the bottle a flocculent precipitate is obtained. That, however, will quickly re-dissolve. Add a little more of the silver solution and the same thing happens, and so on, until it is found that this flocculent precipitate will not re-dissolve, but is thrown down at the bottom of the solution as a precipitate. There must be an excess of silver in the solution to prevent the cyanide causing some reducing to take place. If the

cyanide of potassium is of bad quality the deposit will be thrown down in the solution before one has used the 5 ozs. of solution containing nitrate of silver; but with a good sample of cyanide of potassium it may be necessary to add a few more grains of silver nitrate to obtain the necessary deposit at the bottom of the solution.

The bleached negative is then flowed with this solution, and a very great increase in the opacity will readily be obtained. The action must be allowed to continue until it has darkened to the glass side of the film, but immediately it has reached that stage the action should be stopped, otherwise the cyanide may, and probably will, cause some reduction. The film is then wiped over with cotton-wood and given ten minutes' washing under the tap, thus completing the production of a line negative.—"Phot. Journ.," June, 1916, p. 177; "B.J.," July 7, 1916, p. 381. •

Copying-photographing Same Size.—Dr. H. D'Arcy Power, in some additional notes on the use of the vertical apparatus described in another section of this "Epitome" under "Enlarging," mentions an ingenious application of it for making copies of natural size without any tedious measurements or adjustments. If the object to be copied is placed in the lower compartment and photographed as a negative in the upper compartment, and then, when this negative is developed, it be returned to the upper compartment, the illumination reversed and its projected image received on bromide or other sensitive surface, the lens in the meanwhile not having been disturbed, it is obvious that as these positions are in exact conjugate foci, the image must be absolutely identical; and measurements will show that it is.

For copying many subjects, such as botanical, zoological, or geological specimens, it is a great advantage to have the four lamps controlled by separate switches, so that the illumination may be obtained from one quarter or another for the purpose of emphasising the relief of the subject. The four switches can be conveniently placed on the front of the frame carrying the lamps, and may supplement the main switch attached to the apparatus.—"Cam Craft," June, 1916, p. 223; "B.J.," Aug. 11, 1916, p. 439.

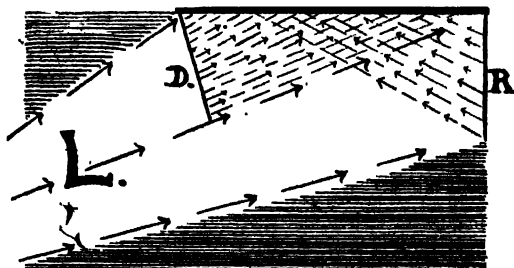
Copying Half-tone Illustrations.—"E. J. M." recommends as an effective means of eliminating the structure of the original, when making copies of half-tone illustrations, the use of a sheet of ground glass. The ground glass should be of the finest description. It is placed in contact with the sensitive plate, glass-side in contact with the emulsion—that is to say, ground side towards the lens of the camera. Allowance requires to be made, of course, for the thickness of the glass as regards focussing. In copying a coarse newspaper portrait (made with a screen of forty lines per inch) by this method no trace of dots should be discovered.

Good results were also obtained from finer prints, when the ground side was used at less distances by turning it the other way round, and interposing thin cardboard at the edges.

It is very convenient in work of this kind to copy, together with the subject, a scrap of printed matter, so that the amount of blurring can be seen.—"B.J.," Mar. 17, 1916, p. 162.

Focussing in Making Enlarged Copies.—When making copy negatives on a greatly enlarged scale from very small originals it is a matter of very great difficulty to get sharp focus owing to the dim nature of the image as well as the fact that there is seldom in such cases any really sharp detail to focus on. To get over this difficulty it is a good plan to keep hanging at one side of the copy-board a length of white thread to which a loop of elastic is tied. The latter can be slipped over a nail or pin so that the thread is stretched tightly across the surface of the original. On examining the image with a magnifier there is seen a lot of fine fibres standing out from the thread. These catch the light and are most easy to focus upon. In the case of mounted prints that have a bend on them, it is important to see that the thread lies along and not across the bend, or it will not be in contact with the print.—"B.J., May 5, 1916, p. 267.

Lighting in Copying.—The diagram shows an arrangement for even illumination of the original which is being copied when light is available only from one source, such as a single arc lamp. In these circumstances almost the effect of a double side light can be



L.—Direction of light.

D.—Diffuser.

R.—Reflector.

got by a combination of a diffuser to soften down the direct rays and a reflector on the other side, as shown in the sketch. Obviously this plan can only be used where the original source of light is a fairly powerful one. Such an arrangement can be conveniently fixed on the wall near the studio lamp, and the diffuser and the reflector hinged to fold flat over the copy-board.—"B.J.," Mar. 31, 1916, p. 199.

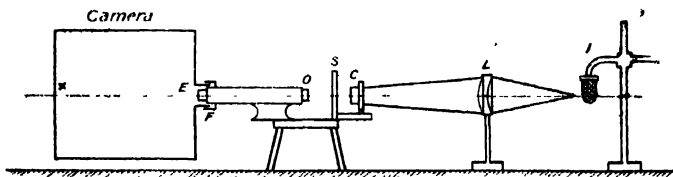
Photo-Micrography.

Central Illumination in Photo-Micrography.—G. Ardaseer recommends the following method when photographing subjects by direct transmitted light. A $\frac{1}{4}$ -inch circular cover glass is cemented with balsam to the centre of the ground glass on which a pencil cross has been made. The camera is extended to about 10 or 12 ins., and the microscope, without eyepiece, objective, or condenser, placed in position, and the light-source placed on approxi-

mately the right position, laterally and vertically. The disc of illumination is now viewed from behind the ground-glass, and matters so altered and arranged that it occupies the central portion of the screen, and concentrically with the cemented cover glass.

The eyepiece and objective are now attached to the microscope, a transparent object focussed, and moved out of the field of view. The illuminated area on the ground-glass is again viewed, and any slight alteration made in the position of the illuminant necessary to obtain a central position for the lighted area. It is nearly always necessary to make this slight alteration, in that objectives for eyepieces are rarely absolutely centred, and consequently it follows that a slight alteration is necessary when either eyepiece or objective is changed.

Without altering the focus, the microscope condenser is now



placed in position, with its diaphragm closed as far as possible. The condenser is racked in or out until the image of the diaphragm aperture is in focus, and this is carefully centred by means of the centering screws, so that when the diaphragm is slowly opened the aperture is found to be perfectly concentric with the field.

Next attention must be paid to the centering of the collecting lens, or, as it is sometimes called, the paralleliser. A piece of white card has a hole cut in the middle the size of the condenser mount. This is held close to the back of the condenser, and the collecting lens so adjusted that its beam, if convergent, just passes through the hole in the card, or, if parallel, illuminates a central disc of the same size as the collecting lens.

The diagram shows the arrangement above described, X being the cross on the focussing screen of the camera; E, the eyepiece; F, the light-excluding flanges; O, the objective; S, the stage of the microscope; C, the condenser; L, the collecting lens, preferably achromatic and furnished with an iris diaphragm; I, the illuminant. Of course, if L and I can slide on rails, or an optical bench, accurately in alignment with the microscope, matters are made much easier.—"B.J.," August 4, 1916, p. 428.

IV.—NEGATIVE PROCESS.

The Gelatino-Bromide Process.

PLATES AND EMULSIONS.

Gelatine Emulsions.—The Gesellschaft für Elektro-Osmose m.B.H., has patented the manufacture of gelatine emulsions by means of gelatine from which the mineral salts and substances having a reducing action have been removed, as also suspended albumen and fat. The process of purification thus referred to has also been the subject of a patent (No. 21,448, 1914). Eng. Pat. No. 21,484, 1914.—“B.J.,” Oct. 29, 1915, p. 706.

X-Ray Plates.—Drs. H. Arnold and M. Levy-Dorn have patented the addition to the customary gelatine emulsion of X-ray absorbing substances, such as thorium hydrate or tungstic acid in a colloidal state for the purpose of rendering the plates more sensitive to and more impenetrable by X-rays and rays from radio-active substances.

It is suggested to use these substances in the form of “sols,” which are absorbed by the emulsion, and do not wash out. The quantity required is not great—usually a few milligrammes of the substance per plate.

Where the substance, e.g., colloidal solution of selenium causes a veil on the plate, the drawback can be remedied by a modification of the process described, viz., by distributing the emulsion on the plate in two separate layers, one on top of the other. The top layer contains the ordinary gelatine emulsion, whereas the bottom layer consists of the emulsion to which the ray-absorbing substances in a colloidal state are added, the bottom layer having thus the nature of a screen.—Eng. Pat., No. 2,243, 1915.—“B.J.,” March 24, 1916, p. 176.

Developers and Development.

B.J. Pyro Soda.—T. H. Greenall recommends sulphuric acid as cheaper than the metabisulphite used in neutralising the sulphite in the “B.J.” formula. He makes a stock solution as follows:—

Sulphuric acid, pure (sp. gr. 1.8)	30 minims.
Cold water	15 ozs.
Soda sulphite cryst.	2½ ozs.

The water is placed in a bottle, the sulphuric acid added to it, the mixture shaken, and then the solid crystals of sulphite added.—“Phot.,” July 18, 1916, p. 46.

Mr. Greenall adds that in making the above solution the whole of the water and the acid must be mixed in a bottle which has been rinsed free from the remains of any previous solution, and the bottle should be kept corked whilst the sulphite is being dissolved. If this is done no trace of free sulphuric acid can be detected. Hot water should not be used. The mixed solution might be boiled afterwards, but, without boiling, the pyro developer compounded with it yields beautifully clean negatives without any stain in the image.—“B.J.,” July 28, 1916, p. 423.

Pyro-Soda Developer for Portrait Film.—The following modified form of the “B.J.” pyro-soda developer is recommended by the Kodak Company for the regular development in quantity of Eastman Portrait Film. The special features of the developer are its excellent keeping qualities and the remarkably clear negatives produced by it. The formula is as follows:—

Pyro	2 ozs.
Sodium sulphite (cryst.)	20 ozs.
Potassium metabisulphite	2½ ozs.
Sodium carbonate (cryst.)	7½ ozs.
Water to	280 ozs.

The following instructions must be strictly followed as the keeping qualities of this developer depend entirely upon the method of making up.

Dissolve the sulphite in 60 ozs. of hot but *not* boiling water. When dissolved add the metabisulphite and then boil for five minutes. Cool down to about 70° Fahr. and add the pyro. Dissolve the carbonate in 20 ozs. of warm water. Pour these two solutions into the tank and make up to 280 ozs. with water. The most satisfactory temperature for developing is 65° Fahr., and it should not be used below 60°. When the developer is first made up, the time of development at 65° is about eighteen minutes.

After the developer has been used for some time, it will be found advisable to strengthen it. There are two methods of strengthening, both of which are satisfactory, and the photographer can use the one he finds more convenient. The strengthening solution is made by dissolving the chemicals given in the formula exactly in the way described, but only making up to 120 ozs. with water.

The first method of using it is to add a small quantity of this concentrated developer after every batch of plates. When using the second method, wait until the original developer begins to work too slowly. Then pour half of it away; add 60 ozs. of the concentrated strengthening solution and make up to the original bulk with water.

An acid fixing bath should always be used.—“Professional Photographer,” Jan., 1916. “B.J.,” Jan. 7, 1916, p. 10.

Pyro-Soda Tank Developer.—W. G. Cullen at the Croydon Camera Club gave a formula for the pyro-soda developer suitable

for tank work. It is a variation of the "B.J." formula, and is as follows:—

Soda sulphite	10 ozs.
Potass. metabisulphite	1½ ozs.
Pyro	1 oz.
Soda carbonate	3½ ozs.
Potass. iodide	4 grs.
Water	140 ozs.

The sulphite is dissolved in about 60 ozs. of hot water, the metabisulphite added, and when dissolved the solution is boiled for a short time. If metabisulphite of soda were substituted for the potash salt, failure resulted.

Mr. Cullen stated that by adding a little dry pyro from time to time the developer could be kept in good working condition for six weeks at least. It yielded beautifully clean and well-graded negatives within twenty minutes even when the developer was dark and muddy. The dose of pyro to add was about 1 grain for every ounce of mixed developer. The plates are gently lifted up and down a few times at the start, and afterwards allowed to develop themselves automatically.

The object of the iodide in the formula is to obviate dichroic fog which sometimes occurs with plates, though not with films.—"B.J.," Mar. 24, 1916, p. 177.

Pyro Developer for Line Negatives.—A developer for great contrast in density is recommended by A. J. Newton, Engraving Department, Eastman Kodak Company, as follows:—

1. Sodium sulphite, anhydrous ...	75 gms.	7½ ozs.
2. Pyro	10 gms.	1 oz.
3. Carbonate soda, anhydrous.....	25 gms.	2½ ozs.
4. Caustic soda, pure.....	2½ gms.	½ oz.
5. Potassium bromide	5 gms.	½ oz.
Water to.....	1 litre	100 ozs.

Dissolve the sulphite in some of the water, then add the other ingredients in order given. If it is required to keep the developer a long time it may be desirable to make up and keep the soda as a separate solution.

This formula has been found to be an efficient substitute for the hydroquinone-caustic developer in regular use among process workers, but rendered more costly by the scarcity of hydroquinone. With the pyro formula given above the time of development at 70° F is about five minutes.—"B.J.," Jan. 28, 1916, p. 62.

Avoiding Pyro-stained Fingers.—Stanley Roberts some year or two ago ("B.J.A.," 1912, p. 589) recommended dipping the fingers in a weak bath of hydrochloric acid immediately after development, or at intervals, when developing a batch of plates with pyro-soda. He now has found that a bath of plain water is just as effective as one of hydrochloric acid. It is important not to put the dry fingers into the developer; they should be rinsed first and also after

every immersion in the developer. If this is done the fingers and finger-nails will preserve their whiteness after the development of hundreds of plates.—"B.J.," April 7, 1916, p. 214.

Diamidophenol Stains on Finger-nails.—The use of acid-proof varnish, e.g., "Vitrivine," of the Vanguard Company, is recommended as a temporary protection for the finger-tips and finger-nails against stains from this developer. A little of the varnish is rubbed over the finger-tips half an hour or so before developing. This preventive has been found to keep the nails white and clean (free from developer stain) during six months' continuous use of it.—"B.J.," Jan. 21, 1916, p. 40.

Diamidophenol Poisoning.—E. A. Norton recommends as the best remedy and a quick cure for skin affection caused by diamidophenol the following lotion:—

Camphorated spirit	1 oz.
Glycerine	1 oz.
Carbolic acid	20 drops.

After washing the sore places, this mixture should be rubbed over.
"B.J.," Nov. 26, 1915, p. 775.

Development of Small Plates.—In order to prevent plates slipping over each other when a large number of small sizes are developed together in one large dish, Charles Macnamara finds it best to dispense with separators and to use Plasticine for holding the plates in place. A piece of plasticine about half the size of a very small pea is stuck on the centre of the back of each plate, and the plate is firmly pressed down on the bottom of the dish, which should be smooth. Of course, if this is not done with care, the fragile little plates may be broken, or the sensitive surface be finger-marked. They may be pressed into place by holding them carefully by the edges, or, preferably, the pressure may be applied on the centre of the plate by the finger-tip covered with a clean piece of fine linen, such as an old handkerchief. The Plasticine holds the plates securely in place, and the dish may even be turned upside down without the plates falling out; but they can be removed at a touch when development is completed. The Plasticine is quite inert and causes no chemical reaction on the developer; and a shilling's worth is sufficient for hundreds if not thousands of plates. It should be kept in a tin box with a cover to prevent drying up. A wooden or cardboard container will quickly extract all the oil and render the Plasticine hard and useless.

Another point to remember is that the quantity of developer sufficient when the plates are flat on the bottom of the dish will not do when they are raised more or less by the small piece of Plasticine beneath, and if the unsightly marks due to uneven development are to be avoided, plenty of solution must be used.—"A.P.," March 20, 1916, p. 228.

Grain and Development.—As the result of exposing strips of dry-plate for a series of increasing times and developing with

solutions containing different quantities of bromide, Ernest Marriage concludes that the fineness of grain in a negative is dependent to some extent upon the development, ample exposure, and the liberal use of bromide in the developer contributing to a finer grain. The author's experiments, however, have not been continued far enough to show whether a rapid plate, over-exposed and restrained in development, is preferable, as regards fine grain, to a slower plate which is given a minimum exposure and treated with an unrestrained developer.—"Process Year Book," 1916, p. 73.

Para-phenylene-diamine Developer.—T. J. Brewster has claimed the following as a novel composition for a developer, and one which largely obviates errors of exposure. The developer is

• Para phenylene-diamine	10 grs.
• Soda sulphite	10 grs.
• Soda nitrite	10 grs.
• Soda carbonate	2 grs.
Water	8 ozs.

The composition of the solution may be varied, but the chief claim by the patentee is the use of para phenylene diamine in conjunction with nitrite.—Eng. Pat. No. 9331, 1915. "B.J.," August 18, 1916, p. 460.

Dry Iron Developer.—A patent, granted to Elektrochemische Werke m.B.H., Dr. O. Dreibrodt and Dr. H. Rohler, claims the use of a dry powder in the preparation of a ferrous oxalate developer. The powder consists of 91 parts ferrous sulphate, 244 parts neutral potass. oxalate, and 155 parts neutral soda glycolate. These are separately ground and then mixed in a vessel which is at once exhausted and heated to, say, 212° F. It forms a yellow powder, 1 part of which dissolved in 4 parts of water forms a good developer.—Eng. Pat. No 14714, 1915, "B.J.," June 30, 1916, p. 372.

Stain-Removers.

Removing Pyro Stain.—A solution worked out by Messrs. Ilford, Limited, for the removal of even heavy pyro stain from negatives is the following:—

Potassium permanganate	50 grs.
Common salt	1 oz.
Acetic acid (glacial)	1 oz.
Water to	20 ozs.

The stained negative should preferably be hardened first in a weak chrome alum solution containing one grain per ounce, unless it has been dried before the treatment is applied, as the film tends to become a little more tender in the process. The negative should then be soaked for ten minutes in the solution given above, and after a brief wash transferred to a solution of potass. metabisulphite 1 oz. in 20 ozs. of water, where it remains until the

bleached image is quite white everywhere to the back of the film.

The image is then re-developed in any non-staining developer, such as hydroquinone, when a good neutral black deposit with clean shadows is produced. All the processes are performed in daylight.

The bleaching solution recommended above appears to require nearly ten minutes to complete its work on a badly stained; heavily coated, and dense negative; and as it is impossible to judge by inspection when this part of the process is complete, it is recommended to adopt this length of immersion for all cases. A too brief treatment can be recognised by the persistence of colour in the bleached image after immersion in the metabisulphite solution, in which event the bleaching solution should be re-applied, but cases requiring more than ten minutes in the latter are not likely to be met with. It is very important that the action of the bleacher should be assisted by constant rocking of the dish.

Those who use pyro in quantity will find this bleacher, followed by the metabisulphite solution, an excellent means for removing the unsightly stains from their hands due to pyro oxidation products.—"B.J.," May 5, 1916, p. 270.

Rain-marks on Negatives.—Edgar Senior, as the result of photo-micrographic examination of rain-drop markings on negatives, has found that the marking consists of a ridge or series of corrugations in the gelatine following the shape of the drop. The gelatine containing the silver which forms the outline of the mark becomes thickened, with the result that in the negative each mark is seen surrounded by a band of greater opacity. Mr. Senior finds that such marks can be completely removed from the negative by soaking in plain water, or better in water to which a little ammonia has been added.—"B.J.," July 21, 1916, p. 403.

Intensification.

Pinholes with Mercury Intensifier.—N. L. Allport advises rubbing the negative gently with cotton-wool while it is in the mercury bleaching solution. If this is done, there will be no trouble in the shape of pinholes in the intensified negatives.—"Phot.," Feb. 1, 1916, p. 91.

Mercury-Iodide Intensifiers.—W. Guttenberg recommends a formula for the mercury-iodide intensifier. It is one issued about 1880 in the instructions for the use of Cramer plates. Potass. iodide, 1 oz., is dissolved in about 5 ozs. of water. Solution of mercury bichloride is then added until the red precipitate of iodide of mercury does not re-dissolve. A little fresh solution of hypo is then added with stirring until the red precipitate is dissolved. The solution is then made up with water to 20 ozs. The intensifier can be used repeatedly until exhausted.

After intensification the negative should be washed so as to cause the maximum formation of yellow iodide of mercury. This yellow iodide must then be thoroughly removed in a weak hypo

solution, which should be allowed to act until no yellowness is visible on examination of the glass side of the negative. For this reason the intensification should be done only in daylight, otherwise it is not easy to tell when the yellow iodide has been perfectly removed. The results have proved quite permanent (without the use of an after-bath of developer) when these precautions were taken. If the negative, on drying, proves to be too dense, it can be reduced to some extent by immersion in the ordinary fixing bath. —“B.J.,” Mar. 10, p. 146, and Mar. 17, p. 163, 1916.

Properties of Bleaching Solutions.—For notes on the effects produced on the silver image by various bleaching solutions, see under the above heading in section on “Toning Bromide and Gaslight Prints.”

Iodides of Mercury in Intensifiers. The mixed solution of mercuric chloride and potass. iodide, used for intensification, possesses quite different properties according to the way in which it is made up, the differences arising from the different phases through which the mixture passes according to the stage at which the addition of the iodide is stopped.

With each small addition of iodide a heavy red precipitate of mercuric iodide is formed, and dissolves again (leaving the solution perfectly clear) until a stage is reached at which the solution shows a faint pink tint. This stage presumably marks the point at which a saturated solution of mercuric iodide in mercuric chloride has been formed. Apparently the mercuric iodide thus obtained in solution amounts to about 2 per cent. (1/50th) of the weight of mercury chloride; but possibly the water is also an important solvent of the mercuric iodide.

At this stage a bleaching solution is formed which does not yield a perfectly white image as does mercury chloride, but a grey one with a little extra density. If treated with hypo solution this bleached image yields rather a darker result than is obtained with plain mercury chloride solution as bleacher. With ammonia also the darkened result is somewhat stronger.

If now further addition of iodide is made the whole of the mercury is thrown down as red mercuric iodide, but it is difficult to tell when this second stage is exactly reached. The only practical way is to calculate the quantities of potassium iodide and mercuric chloride which are required, namely, 332 parts of iodide to 271 of mercury chloride, say, 5 to 4, which gives the iodide in the slight excess which appears to be of advantage.

The mixture obtained at this stage is of no use by itself, but forms the starting point from which to produce a solution of mercuric iodide. This solution can be obtained by a further addition of potassium iodide up to a point at which the final proportions are 27 parts of iodide to 11 of mercuric chloride. This final mixture (clear) can be made by mixing 27½ parts of 4 per cent. mercuric chloride solution with 27 parts of 10 per cent. potass. iodide solution, or, better, by adding nearly all the iodide solution and then the remainder slowly in small portions until the solution clears.

This mixture of mercury-potassium-iodide is again different in its bleaching action. It yields a brown image which, on washing the plate in water, changes to a bright orange, this process alone yielding a very great degree of intensification. The intensified plate is very considerably reduced by treatment with hypo solution, and the colour is changed to brown. The orange-coloured image (obtained by bleaching and washing) is changed to almost a black by soda sulphide solution yielding very great intensification.

Instead of potass. iodide as the solvent for the red mercuric iodide other chemicals can be used, *e.g.*, soda sulphite or hypo. The former yields the Lumière intensifier: the latter, a modification of the Edwards formula.

With hypo there is obtained a saturated solution of mercury iodide in hypo, which converts the black image of a negative into one of brown. This brown image clears somewhat, but still remains brown (not changing to orange) on washing. A subsequent bath of hypo darkens the image still more and reduces its intensity, rendering the deposit more transparent. The result has slightly greater printing density, but still greater intensity is obtained by using a bath of sulphide instead of hypo.

The Edwards formula and most of the formulæ that are in use form a sort of compromise between the solutions of mercuric iodide in potassium iodide, and in hypo, described above. In some cases the formulæ prescribe more iodide than is necessary to produce mercuric iodide, say, 4 to 3, or 3 to 2 instead of 5 to 4, while in others it is directed to add iodide until the precipitate is nearly all dissolved and then clear with a few drops of weak hypo solution. The last prescription gives a result that does not differ materially from that given by a plain solution of mercury iodide in potassium iodide. The washed image is not quite so bright an orange, but that is about all the difference. If we use one of the intermediate formulæ the result is a solution of mercury iodide partly in potassium iodide and partly in hypo—or equivalent to a mixture of two such solutions. The colour of the washed image is then modified, assuming some intermediate stage between orange and brown, and, generally, the browner the washed image the darker is the final image produced by the bath of hypo generally recommended.

It is inadvisable to add more than enough hypo to dissolve the mercuric iodide, because an excess converts the intensifying solution into a reducing one. Also no hypo must be added until the second phase is fully reached. If any unconverted mercury chloride remains when the hypo is added the solution at once becomes cloudy, owing probably to the formation of some forms of thiosulphates, which, like most metallic thiosulphates, appear to be very unstable. The red iodide will disappear, but be replaced by white, yellow, or brown precipitates of unknown composition.—"B.J.," April 21, 1916, p. 231.

C. Welborne Piper has found, in reference to the properties of mixtures of mercuric chloride and potass. iodide, that a much larger quantity of mercuric iodide can be got into solution with mercuric chloride as the solvent by using heat. If the mercuric

chloride solution be employed hot the dissolved mercuric iodide will amount to 1/10th of the mercuric chloride taken instead of to 1/50th when the mixture is made in the cold. The following formula can be used:—

A. Hot water.....	20 ozs.	200 c.c.s.
Mercuric chloride	1 oz.	10 grs.
B. Cold water	5 ozs.	50 c.c.s.
Potass. iodide	45 grs.	1 gm.

Dissolve the mercuric chloride, and when dissolution is complete add solution B, not all at once, but in small quantities, say a drachm or so at a time, shaking after each addition, until the solution becomes clear, and, if necessary, heating further. If B is added all at once, a large amount of precipitate is formed, which takes some time to dissolve. When perfectly clear, the solution is allowed to cool, and when it reaches normal temperature a little red precipitate will reappear, which must be removed by filtering. Care should be taken not to inhale the steam from the hot chloride solution. This solution is used as a bleacher of the negative in the customary way, the greyish image being treated with either sulphite or ammonia, and yielding an image which is of brownish hue in the lighter tones, but after washing dries to a black throughout.

Adding mercury to iodide solution:—For the preparation of a solution of mercury potassium-iodide (which is the compound most commonly relied upon for intensification with mercury-iodide) the simplest and most direct way is to add solution of mercury bichloride to iodide solution until a permanent precipitate just begins to be formed. The solution can then be cleared by addition of a drop or two more of iodide solution or a little hypo or sulphite. The minimum quantity of either hypo or sulphite should be added: excess will lead to the formation of mercurous iodide, a green insoluble compound which is useless for intensification purposes. It is better to dispense with either hypo or sulphite, except in very minute proportions: for the purpose of getting a clear solution, potassium iodide is much safer. Mr. Piper prefers as an intensifier the solution obtained by adding potassium iodide to mercury chloride, stopping the addition of iodide at the second stage mentioned in the previous abstract. The intensified plates, when ammonia is used as the darkening agent, possess greater density as compared with those obtained with mercury chloride alone as the bleaching agent, and the result is blacker and cleaner looking.—“B.J.,” April 28, 1916. p. 248.

Reduction.

Farmer's Reducer.—John H. Gear, in the course of experiments on the addition of various substances to Farmer's reducer (hypo-ferricyanide) for the purpose of prolonging the time during which the reducer retains its activity, has found that addition of 4 grs. of potassium bromide to 1 oz. of the mixed reducer prolongs the time during which the reducer keeps in working condition by about 30 per cent. Addition of the same quantity of manna was found

to prolong the period of activity by 50 per cent., whilst a time of useful action of more than double was secured by making up the reducer with addition of glucose in the proportion of 5 minims per ounce of the mixture. Mr. Gear states that by the use of a reducer made up with this small addition of glucose negatives of great density may be thinned without the solution losing its power before the operation is complete.—“Phot. Journ.,” June, 1916; “B.J.,” July 7, 1916, p. 378.

B. Brougham finds that addition of ammonium sulphocyanide to Farmer's reducer prolongs the time of effective action. He makes 10 per cent. stock solutions, and uses ferricyanide, 2 drs.; hypo, 2 drs.; sulphocyanide, 2 drs.; with 2 ozs. of water.—“B.J.,” July 14, 1916, p. 399.

Non-Ferricyanide Reducer.—W. J. Smith, of the Bolt Court School, has worked out the following as a substitute for Farmer's reducer, which is much cheaper than the latter with ferricyanide at a war price. It can be used for reduction in wet and dry plate negative making. In screen negative work it attacks the edges of the dots before the density is affected; in fact, it will do exactly what the ferri-hypo will do, and is more stable when mixed. The following is the formula employed at the Bolt School of Photo-Engraving, where it has replaced the ferri-hypo reducer:—

A. Water	25 ozs.
Copper sulphate	1 oz.
Sodium chloride	1 oz.

When dissolved, add sufficient .880 ammonia to clear the solution, which should be a rich clear ultramarine colour.

B. Hyposulphite of soda	5 ozs.
Water	25 ozs.

For use take equal parts of A and B. The usual methods of intensification can be carried out after reduction.—“B.J.,” Oct. 20, 1916, p. 574.

Mercury-Cyanide Reducer.—D. Bachrach recommends as a simple and most controllable method of softening the contrast of hard negatives a single-solution reducer, consisting of a mixture of mercury bichloride and potassium cyanide. The action of the solution is to convert the silver image into silver chloride, which is immediately dissolved by the cyanide. A suitable formula consists of equal parts of a saturated solution of mercury bichloride and a 6 per cent. solution of potass cyanide.

A hard or over-dense negative is immersed in this solution, kept in motion occasionally, until the negative is soft enough, when it should be thoroughly washed. Then, as a matter of precaution, the last trace of the mercury salt can be neutralised by immersing the plate for half a minute in a solution of protosulphate of iron (ferrous sulphate), and then rinsed under the tap. The beauty of this process is that it brings down the high-lights and does not destroy any detail in the shadows, unless by carelessness it is very

much overdone. The hardest negative will yield to this treatment. —"B.J.," Mar. 17, 1916, p. 163.

Combined Permanganate-Persulphate Reducer.—Norman C. Deck recommends the following formula as a reducer for negatives:—

Potass permanganate, 1 per cent. solution	20 minims
Ammonium persulphate	10 grs.
Water to make	2 ozs.

The reducer should preferably be made up just before use, for which purpose the "tabloid" persulphate may be used, one "tabloid" (11 grs.) being near enough.

The reducer is found to have the following advantages:—The action starts at once and is regular—that is, does not spurt towards the end like persulphate. • Hypo in the negative through imperfect washing does not interfere with it, nor does the use of a previous hardening bath. The solution is not liable to fail in its action at times from some unknown cause; also it is easier to judge of the action than with permanganate alone, and the mixture appears to remain in active working longer than acid permanganate. So far as can be judged from trials without density measurements, its action is proportional throughout the tones of the negative.—"Austr. Phot. Review," June 15, 1916, p. 302; "B.J.," July 14, 1916, p. 391.

Farmer-Persulphate Reducer.—N. Hunter recommends a mixture of these two reducers. If one adds, say, 1 part persulphate (1 to 20) to 3 or 4 parts Farmer you have a proportional reducer as near perfection as there is any need for. This combined reducer does not stain like Farmer by itself; it acts very quickly, especially if negatives are put in dry; there is no need for salt or sulphocyanide to keep it in working order longer; one solution will reduce a dozen or more negatives in succession, and there is no need for a sulphite stop-bath.—"B.J.," Oct. 20, 1916, p. 575.

Retouching.

Titles on View Negatives.—Daniel Nyblin describes a method used by him for some year past for neatly impressing titles and other lettering on view negatives, the lettering printing white.

The titles which are to be applied to the negatives are first printed on the customary lithographic transfer paper, but using paper of a thin substance. The lettering can be printed on to this transfer paper by any letterpress printer on an ordinary typographic machine, but as it is necessary to use a fatty (that is lithographic) ink, and as some typographic printers will say that they cannot work with such an ink, it is better to give the job to a lithographer because the prints must be made in a fatty ink.

In this event, the lettering having been set up in ordinary type, a transfer is made to a lithographic stone, from which it is printed in fatty ink on to the paper for transferring to the negative. This latter method is not as cheap as the former, but it gives the best result in the end.

The lettering should be transferred to the negatives within a short time of the impressions having been taken on the transfer paper. If these impressions are kept for longer than three or four days the ink becomes too hard and then transfers much less easily to the gelatine film.

The printed sheets of transfer paper are cut up into suitable pieces, so that one title comes on each piece. These cut pieces are placed on a damp pad of three or four sheets of blotting-paper, printed side up, and a sheet of dry blotting-paper laid upon them. In a few minutes the pieces are sufficiently moist to be ready for application to the negatives.

The negatives should be dry and clean. Particular attention must be given to the complete absence of greasy finger-marks, otherwise the piece of transfer paper will not attach itself properly to the film. The negative is placed on a retouching desk, film side towards the operator, and the somewhat moistened sheet of paper bearing the lettering laid upon it in the required position and gently pressed into contact with the fingers. Then a sheet of dry blotting-paper is laid over the piece of transfer-paper for the purpose of removing the moisture from the latter. This operation is repeated a second time, the second piece of dry blotter being rubbed firmly into contact by means of the finger-nail.

The negative is now stood aside for a few minutes to dry, but it should not remain too long, since the piece of transfer-paper must not become too dry, otherwise it sticks to the negative, and it will be difficult to remove it without damage either to the film or to the lettering.

What is required is a superficial drying, long enough to allow the ink impression to transfer itself to the gelatine film, but not long enough to cause the transfer paper to stick. Very little experience is required to carry out this part of the process. The transfer-paper is then moistened with a small brush dipped in a little water, and by means of a thin knife-blade a corner of it is lifted carefully and the paper stripped away.

The lettering will be seen sharply transferred to the negative, but not of sufficient opacity to yield a perfectly white title on the print. In order to obtain complete opacity of the lettering, the latter should be rubbed gently over with a little bronze powder applied with a small tuft of cotton-wool, the wool being previously dipped in the powder. The bronze powder attaches itself only to the lettering, leaving the film entirely unmarked (that is, if the film is dry) and the lettering stands out of great opacity and sharpness.

It is advisable afterwards to varnish the negative for the purpose of preventing possible damage to the lettering during the making of prints.

This method of impressing titles on negatives is cheap and is very easy and rapid. It gives altogether the best result, inasmuch as the lettering is printed on the negative itself and is as permanent as the latter.—"B.J.," June 9, 1916, p. 327.

Removing Figures from Groups.—A. V. Chandler describes the rapid and effective use of the "Buildup" retouching medium for



Fig. 1.—Print from original negative.

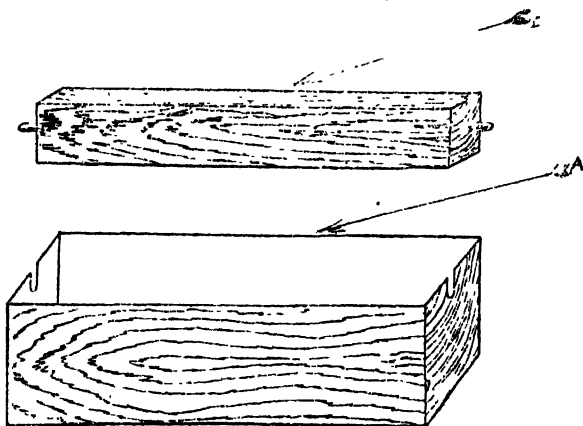


Fig. 2.—Print from negative after removal of one figure by the method described.

the removal of one figure from a group negative, or similar work. The two illustrations are an example of its use. The negative is

made perfectly dry, and the high-lights of the figure to be removed are carefully scraped away with a sharp knife. "Billdup" is then flowed over the film side of the negative in the same way as varnishing. The negative is then warmed thoroughly and worked upon with a soft pencil, which takes freely, neatly matching the surroundings. Should still more pencil work be desired, the negative can be flowed over again with "Billdup" without fear of removing the work already applied. In retouching heavily lined or freckled faces where extra work is required, "Billdup" can be used in exactly the same manner as retouching medium. If the negative is warmed after application a much better "tooth" can be obtained.—"B.J.," Nov. 12, 1915, p. 737.

Retoucher's Pencil Sharpener.—The drawings show a convenient accessory for the retoucher. It consists of a little oblong wooden box, about 8 ins. long, with a notch cut in each end, into which the wooden block (B) fits. On each side of this block different degrees of sandpaper are glued down, using a fine one for finishing.



It will be seen that as the block is turned from time to time the lead from the pencil drops into box, and so provides one with a ready supply of lead powder for stumping on matt-varnished negatives, etc. In addition to this it keeps the retouching desk tidy and free from loose lead powder, as is often the case when an odd bit of sandpaper is used.—"B.J.," October 29, 1915, p. 704.

Stripping.

Stripping Negatives Dry.—A useful and speedy method of stripping the film off glass plates in a dry condition for carbon printing, etc., is the following:—

The negative is thoroughly well washed after fixing. Then immerse for five minutes in a solution of potassium carbonate (9 ozs. potass carbonate in 8 ozs. water). Remove from the solution and blot off surplus moisture with a soft cloth, rub dry with another cloth, and then cut through the film with a penknife at the top edge. When thoroughly dry—i.e., in about ten minutes—insert a needle under the film at the top corner and pull steadily, when the film will be found to leave the glass with perfect ease and certainty. This method appears to have no deleterious effect on the film at all.—“B.J.,” May 5, 1916, p. 267.

Stripping Gelatine Plates.—In a communication from the Eastman Research Laboratory, S. M. Fernald has described the following method of stripping the film from gelatine dry-plates for transference to other supports:—

The portion of film to be stripped is first cut around with a knife. The following solution of fluoride and formaline may be flowed over the plate or applied with a camel's-hair brush to the portion of film to be stripped:—

Sodium fluoride, 4 per cent. solution	2 parts.
Formaline (40 per cent. formaldehyde)	1 part.

The film will become loosened from the glass in about one minute, and may then be easily lifted by applying over it a piece of dampened paper, lifting carefully one corner and stripping the paper and film away together.

If reversal of the film is required it is easily transferred to a second piece of paper and from that to the final support.

The glass on which the film is to be laid should be perfectly clean and flowed with a 5 per cent. solution of gum arabic. A little glycerine added to the gum solution tends to improve the condition of the stripped film, which otherwise becomes rather over-dry and horny owing to the formaline.

With small portions of film there is very little danger of distortion or tearing, but if the plate is first bathed for ten minutes in formaline before applying the stripping solution the film will strip equally well, and is tougher and less liable to distortion.

When stripping large films the plate may first be flowed with:—

Collodion	15 parts.
Glycerine	1 part.

and as soon as the collodion film has become set, flowed or immersed in the fluoride-formaline solution. The time required for loosening the film may be slightly longer, but this method gives a tough, rubbery film, considerably stronger than film stripped without the collodion coating.

The fluoride-formaline formula may be used to strip a dry-plate negative which has been coated with a thin rubber solution, and then with the collodion and glycerine solution; this gives a film which has extreme tensile strength, is tough and flexible, and resists a shearing tear fairly well. The time required to loosen from the glass is much longer, but this objectionable feature may be, in a

measure, overcome by the addition of 2 c.c.s. hydrochloric acid to 1 litre of stripping solution (10 minims to 10 ozs.). The acid should not be added until ready to use, and the plate with the loosened film should be thoroughly rinsed to remove all traces of acid.—“B.J.,” Jan. 21, 1916, p. 40.

Film Photography.

NEGATIVES ON FLEXIBLE SUPPORTS.

Numbering Roll Films for Trade Developing.—K. R. Bamford uses a printing-box for the purpose of impressing, by the action of light, the series number upon each roll of film which comes in from customers for development and printing. The box consists of a simple, completely enclosed chamber, containing an electric light bulb with outside switch. Convenient dimensions are 5 ins. wide by 5 ins. deep by 8 ins. long. In the top of the box is a slot about 1 in. wide by $\frac{1}{4}$ in. deep, with a small piece of glass let in flush. Immediately below this slot (inside the box) is a simple shutter—one which can be opened and closed by a touch of the finger. The box is used in the dark-room. In numbering each roll, the actual envelope in which prints are to be delivered or a special number slip is laid on the top of the box, with the number over the slot. The sensitive film is then unwound and the end laid over the number. Exposure is then given by the switch for a time, ranging from 1-25th of a second to 2 seconds, according to the light and the thickness of the paper upon which the number is written.—“B.J.,” Mar. 31, 1916, p. 199.

Fixing and Washing Roll Film.—The following is a method for preventing films from curling during fixing and washing without the need of continuous attention to them:—The films are handled in deep porcelain dishes of 15 by 12 size. This size dish will take nearly all films of the popular sizes of folding pocket cameras, but smaller dishes may be used to meet individual requirements.

After developing, the film is washed in a dish of clean water and the clips released. The two ends of the film are brought together, so that the sensitised side is facing outwards. This will form a loop between the third and fourth exposure (six-exposure reel). Note these exposures, and along the space between them gently squeeze the film so that a flat edge is formed, the exposures coming back to back flatly.

Adjust the ends of film whilst holding exposures Nos. 3 and 4 firmly, so that 2 and 5 and 1 and 6 lie evenly against each other.

When this is done, grasp the ends firmly and release what was previously the centre. Pin the ends together on the blank, unexposed portion. The tendency of the film to curl outwards is thus counterbalanced, and the film lies firm and flat, which ensures, with a little periodical attention during fixing, thorough fixation, and a minimum of trouble whilst washing.

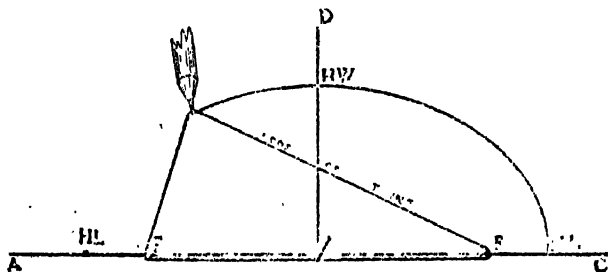
Twelve-exposure films are dealt with in sixes; with eight-exposure films (V.P.K.) the four and five exposures become the centre, and larger-sized films are dealt with, cut in fours or twos.—“B.J.,” Jan. 21, 1916, p. 40.

Removing Scratches from Film Negatives.—The negative is put on a smooth flat surface, gelatine side downwards, and being securely held with the outspread fingers of the left hand, a piece of cotton-wool with a few drops of methylated spirit on it is held in the right, and the surface is given a good polishing all over with it. This will be found to leave it quite smooth and glossy. Of course, the film must not be allowed to slip and ruck up or the negative would be ruined, as it would be very difficult to get it quite flat again. The other side of the film can be treated in the same way, should it be necessary; but in this case the rubbing, if carried on too far, will end in reducing the parts rubbed.—“Phot.” Oct. 19, 1915.

V.—PRINTING PROCESSES.

Printing Operations.

Making Oval Masks.—Arthur Whiting gives the following directions for drawing ovals of any required size or shape for use in cutting masks or trimming prints. On a piece of masking paper i.e., either black or orange paper of the size desired mark the centre (B), and draw horizontal and vertical lines through it.



Divide the length of desired oval by two. Call it "H.L." (half length). Mark this distance on the horizontal line (A.C.) on each side of the vertical line (B.D.).

Next divide width of desired oval by two, calling this "H.W." (half width). Mark this distance on the vertical line (B.D.) commencing from B. Then take a slip of paper (or use a pair of compasses) the exact length of "H.L." from B. Place one end exactly at "H.W." and the other end exactly on the horizontal line on each side of B. The point (on either side where the slip of paper meets the horizontal line) will give the exact place to drive in the pins (or thin wire nails), as shown at F and E. A

loop of thread, or fine twine of the exact length to reach from one nail (F) past the other nail to H.L., is then placed over both nails or pins, and a pencil point inserted in the H.L. end of this enables one to describe a perfect oval of the dimensions required. Although this is a very old dodge, there are few who are acquainted with the rules given above; and, further to simplify matters, a table is appended herewith giving a number of measurements in inches and fractions thereof, which will enable anyone to produce at once any of the usual sizes of ovals called for. All ovals having the same proportion letter are uniform in shape with each other and may be used together in multiple masking. Those numbered A bear the proportion of one to two; B, two to three; C, three to four; D, four to five; E, five to six; F, five to seven.

Approximate size of oval.	Proportion letter.	Length of loop.	Distance of Nails Apart.	Approximate size of oval.	Proportion letter.	Length of loop.	Distance of Nails Apart.
1½ × 1	B.	1½	1½	6 × 5½		4½	3
2 × 1½	C.	1½	1½	6½ × 5½		5	3½
2½ × 1½		1½	1½	7 × 5	F.	6	5
2½ × 1½		2½	2	7 × 6½		5	3
2½ × 2	D.	2	1½	7½ × 5	B.	6½	5½
2½ × 1½		2½	2	7½ × 5½		6	4½
2½ × 2½		2½	1½	8 × 5		7½	6½
3 × 1½		2½	2½	8 × 6	C.	6½	5½
3 × 2	B.	2½	2½	8½ × 6½		7	5½
3 × 2½		2½	2	8½ × 7		6	3½
3 × 2½		2½	1½	9 × 6	B.	7½	6½
3½ × 1½		3	3	9 × 7½		7	5
3½ × 2½	F.	3	2½	10 × 8	D.	8	6
3½ × 2½		2½	2	11 × 8½		9	7
4 × 2	A.	3½	3½	11 × 10		8	5
4 × 2½		3½	3	12 × 6	A.	11½	10½
4 × 3	C.	3½	2½	12 × 8	B.	10½	9
4 × 3½		3	2½	12 × 9	C.	9½	7½
4 × 3½		3	2	12 × 10	E.	9½	6½
4½ × 3½		3	1½	14 × 10	F.	12	10
4½ × 3	B.	3½	3½	15 × 11½		12	9
4½ × 3½		3½	3	16 × 12	C.	13½	10½
4½ × 3½		3½	3	17 × 14		12	7
4½ × 3½		3½	2½	18 × 15	E.	14	10
5 × 4	D.	4	3	20 × 16	D.	16	12
5½ × 3½		5	4½	22 × 17		18	14
5½ × 4½		4½	3½	24 × 12	A.	22½	20½
6 × 3	A.	5½	5½	24 × 16	B.	21	18
6 × 4	B.	5½	4½	24 × 18	C.	19½	15½
6 × 4½		5	4	24 × 20	E.	18½	13½

Printing from Cracked Negatives.—F. Moore, junr., recommends, as a means of avoiding a crack in the glass of a negative showing on the prints, the use of an undeveloped dry-plate placed with its film-side in contact with the glass side of the negative when making the print. The only drawback to the method, and that a slight one, is the longer exposure required for the bromide or gaslight papers.—“B.J.,” May 5, 1916, p. 267.

Facsimile Signatures on Photographs.—D. Charles describes a neat method of printing signatures on portrait photographs by a photographic process.

If it is a pen-written signature that is to be reproduced, it is written on a bit of fixed-out dry-plate or roll-film, preferably with opaque colour or Indian ink, while if a pencil effect is desired, such as professionals use on sketch work, it is written on ground-glass, and it is essential that the pencil used should be a soft black one, however delicate the depth of the final result is to be. This is because one has to get a reasonable amount of opacity in the writing which an ordinary H.B. will not give. If the ground-glass is rather coarse, so much the better, as the pencil line will have a certain “texture” which will assist the effect of verisimilitude in the final results.

The next thing is to put the signature in contact with a slow process or lantern plate in a printing-frame, and give a brief exposure which on development will give fair density with little or no veiling of the lines. It is not often necessary to reduce and then intensify as in the case of ordinary line negative making, and it will generally preserve the character of the writing better if this can be avoided. Only a small bit of plate is needed for each signature, as each one can be fixed with lantern-slide binders in a small hole cut in a suitable position in a piece of card. When printing these signature negatives on to bromide paper it is an advantage to fasten a piece of thin white paper on the glass side, so as to soften the light considerably, otherwise they are almost sure to be over-exposed and to print up too boldly.—“B.J.,” August 4, 1916, p. 433.

An Opaque for Vignettes.—B. F. Weloh gives the following formulæ for opaque mixtures for use in making vignetting cards by the professional method of cutting in a card a hole somewhat larger than is required for the vignetting effect, covering it with tissue paper, and painting the necessary “teeth” upon it with opaque. The teeth start about half an inch from the edge of the opening, and are broadened in width as they reach the cut edge of the cardboard. This is a far quicker and more effective method than cutting serrations in the card itself.

To make up a most useful opaque, take:—

Red lead	1 part.
Chrome yellow	1 part.
Red ochre	1 part.

All obtainable from any colour merchant.

These colours, being in powder form, can be mixed together dry—in an old cup or basin preferably. Next add a small quantity of boiling water, sufficient to bring to a stiff paste, taking care to stir well all the time. Having done this, add a small quantity of ordinary office gum. Work this well into the solution. Providing a good quality gum is used there is no need to add any preservatives whatever. This mixture when used will be found to be more opaque than Indian ink, and the cost considerably less.

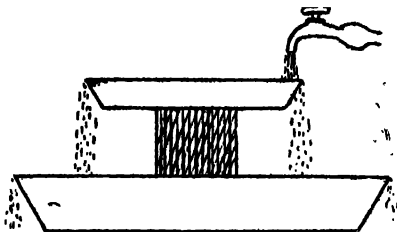
A more dense material suitable for blocking out large portions of negatives can be made of the following:—

Yellow ochre	1 part.
Chrome yellow	1 part.
Red ochre	1 part.
Black, either ivory or vegetable	$\frac{1}{2}$ part.

Mix and grind well together, and when thoroughly mixed add hot water till dissolved. Follow by a generous amount of gum as previously described. If kept in a liquid state in a wide-mouth bottle it will always be found very useful.

These mixtures have been found to work and keep admirably, and are to be preferred to any others that have been tried. They keep well either in liquid form or in cakes. Should it be desired to make a quantity and keep in cake form, simply mix to stiff paste, spread out in the lids of shallow tins—such as small biscuit tins—and store away to dry. In cake form, for use simply wet a little and apply with a brush in the same manner as any other ready-made and bought opaque or water-colour.—“B.J.,” Dec. 3, 1915, p. 785.

Washing Small Prints.—When washing tiny prints or films such as locket photographs or “vest-pocket” film-packs in a dish, they are very liable to get washed overboard and to make a bee-line for the waste-pipe. To prevent this occurring, the dish may be



supported on a pot which is standing in a larger dish. Should a print slip out of the top dish it falls into the lower one, where the flow of water is quite gentle and very unlikely to carry the print any further.—“B.J.,” Feb. 11, 1916, p. 87.

Frames for Washing Prints.—H. T. Forbes recommends the following pattern of frame for use in washing prints, a frame

serving the purpose of keeping prints apart from each other in the wash water. The frame measures about 9 by 7 inches, the two side pieces being of $\frac{1}{2}$ -inch wood and the other two of $\frac{1}{4}$ -inch. The depth (thickness) of the frame is about 2 inches. Round each frame fine string is wound tightly and secured. When a number of prints are to be washed, as many as it will hold without overlapping each other are laid out on these strings of one frame, the next frame is put on top and a fresh lot put on it, then the next frame, and so on. Finally, the frames are bound together with elastic bands and put bodily into the washer. Every print is thus exposed to the action of the water on both sides, the narrow ends allowing the water to permeate freely between the frames.—“Phot.,” June 27, 1916, p. 451.

Defects on Squeegeed Prints.—A careful examination of the surface of a print which has been squeegeed to glass will often show that it is freely covered with specks, hairs, etc., blemishes which will not be perceptible when the print has been hung up and allowed to dry in the ordinary way. These blemishes are undoubtedly due to the vigorous polishing which is usually given to the glass just before squeegeeing. The polishing material provides some of the dust, etc., itself, but more is due to the electrification of the glass which it brings about, causing it to attract any floating particles in the neighbouring air. A complete preventive is to immerse the glass in the water in which the print is lying, bring the two into contact, and then to lift them out together and squeegee. This would also very greatly reduce the risk of any air bells between the film and the glass; in fact, none could be present unless with gross carelessness in the squeegeeing. When the prints are likely to be examined under a magnifying glass, as is often the case when they are photo micrographs or similar records, their appearance is greatly improved by avoiding dust particles in this way.—“Phot.,” June 20, 1916, p. 435.

A Drying Net for Prints.—A very practical means for the drying of prints in considerable numbers consists of a net which can be the full length of the work room. Fig. 1 shows the construction of one in actual use measuring 6 yards long by 1 yard wide.

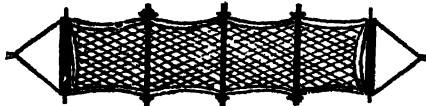


Fig. 1.

It is made of “mosquito-net,” which costs about a shilling a yard, and is bound at the edges with strong tape. This wants to be done carefully, and is a slow job, but it is necessary to prevent fraying and stretching. Tape loops are sewn at the corners and at intervals along each side. Lengths of dowel-stick are cut a

couple of inches longer than the width of the net, and a nail driven in through each end and their heads cut off. These are slipped through the tape loops as shown in Fig. 2, the nail preventing the loops from slipping further. For the ends it is usually necessary to use broomstick, as anything thinner bends under the strain. In these the nails are driven in endways instead of across, and a piece of cord is tied to the nails as shown in the drawing, and a loop tied in the centre.

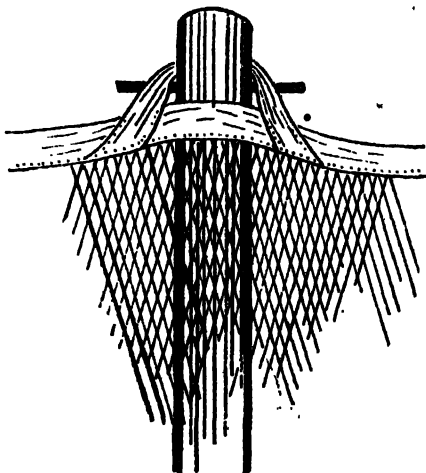


Fig. 2.

On one end wall is fixed a stout screw hook, and on the other a cord and pulley, with a hook on the end of the cord. When the cord-loops are slipped on to the hooks and the net stretched by means of the cord and pulley, it will hang quite horizontal if the loops are properly central. If it is arranged that the net hangs just overhead one can swing it down one side at a time for laying on or removing prints. When the net becomes soiled it takes only about five minutes to get it down—slip the tape loops off the rods and put up a fresh net while the soiled one is sent to the laundry. "B.J.," April 14, 1916, p. 223.

Print-out Papers.

Soap-Gelatin Substratum for Emulsion Papers.—M. Roth has patented a substratum for emulsion papers, consisting of insoluble or sparingly soluble fatty soap in a solution of gelatine, rosin, etc. The object of this coating is to prevent silver salts in the emulsion from permeating the paper or reacting with any metallic impurities.

in the paper. The process may be applied either in the paper-making machine or to the finished product. It is intended to dispense with baryta coating or to employ only a thin coating.

Further, addition may be made to the soap emulsion of compounds such as alkaline bromides or chlorides for the purpose of precipitating any soluble silver compounds (from the sensitive photographic emulsion) left unprecipitated by the fatty acid of the soap.

A formula for the soap emulsion is:—Gelatine, 2 parts; fatty acid, 1 part; water, about 20 parts; or the fatty acid may be reduced to 1 or to 0.25 parts.

The coating of fatty soap may be formed in an insoluble form by the use of alum to form alumina soaps.

The chloride, bromide, phosphate, or other compound for forming insoluble silver compounds is dissolved in the gelatine-soap emulsion.—Eng. Pat. No. 21,884, 1914. "B.J.," Mar. 24, 1916, p. 175.

Bromide and Gaslight Papers.

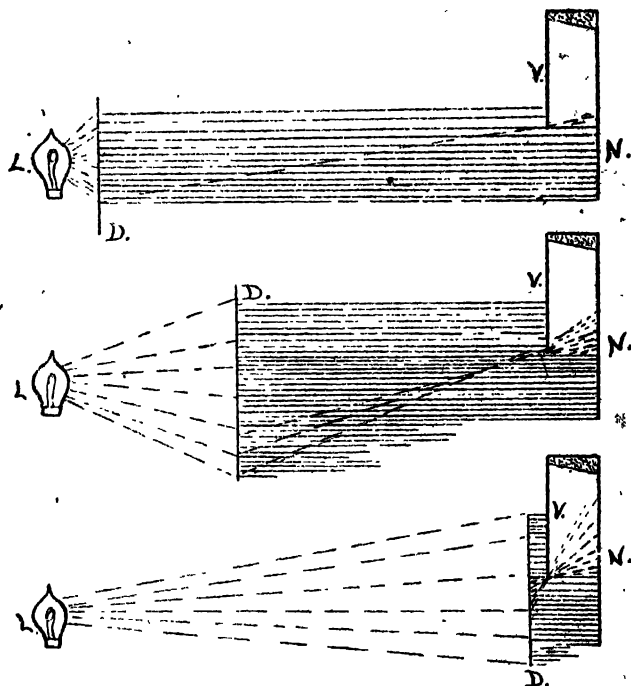
Electric Lamps for Bromide Printing Machine.—"Alpha" points out the usefulness of electric bulbs of which only the tips are frosted in preference to the clear or all-frosted lamps as the source of illumination in bromide printing machines, where the lamps are placed vertically below the negative. The frosted tip diffuses the light which passes directly upwards through the negative, whilst the full power of the filament falls upon the reflecting walls of the printing box, supplementing the direct illumination.—"B.J.," Oct. 29, 1915, p. 704.

Vignettes on Development Papers by Artificial Light.—D. Berlin gives hints as follows on the printing of vignette portraits on bromide or gaslight paper when using either a printing frame or box exposure. Whichever is used, it is well to adopt a standard distance from the negative to the vignetting card—say about 1 in. and in most cases the source of light should be central with the vignetting aperture, otherwise the vignette will be one-sided.

The controlling factor is the diffuser and its position relative to the light and the opening of the card. The nearer to the light the diffusing screen is, the sharper will the edge of the vignette be; and the nearer to the card, the softer the gradation. The reason for this will be seen on reference to the diagram, in which L is the light, D the diffuser, V the vignetting card, and N the negative. If we regard the diffuser in each case as the source of printing light it is obvious that the direct rays which pass straight through the aperture to the negative are more powerful than the diagonal ones from the margins. Also the nearer D is to V, the further up on to N can some of these diagonal rays get.

In practice the method is to have a movable diffuser. Where a printing-frame is used on a shelf, a wooden frame holding tissue-paper or ground-glass, is stood in front of it. In a printing-box a removable glass shelf is fixed about an inch below the top on which

to lay vignetting cards, and below that a series of pegs or wooden strips on to which can be slipped a sheet of ground-glass or a tissue-covered frame at various distances. It is preferable to be able to adjust this by a door at the front of the box to avoid shifting the negative and the vignetter about.



In some cases it may be found necessary to use cotton-wool for specially thin parts just as in daylight work. In extreme cases, where the background to be vignettted is rather dark, it may be necessary to have another sheet of tissue on the hole in the vignetting card itself, and in such cases still further softness of vignette can be got by matt-varnishing the negative. It is surprising what an improvement is sometimes obtained by that slight extra diffusion.—“B.J.,” Feb. 11, 1916, p. 86.

Border Printing at One Operation.—D. Charles has worked out a method of printing line or tint borders which avoids the usual troubles connected with registration and effects considerable saving in time. It is, however, suitable only for bromide paper, and, in

fact, only for the thin varieties of bromide coated on a base of good quality. The method consists in using a printing frame, allowing of full exposure of the paper on one side (that from which the border is printed), and of about two-thirds' exposure on the other—that is

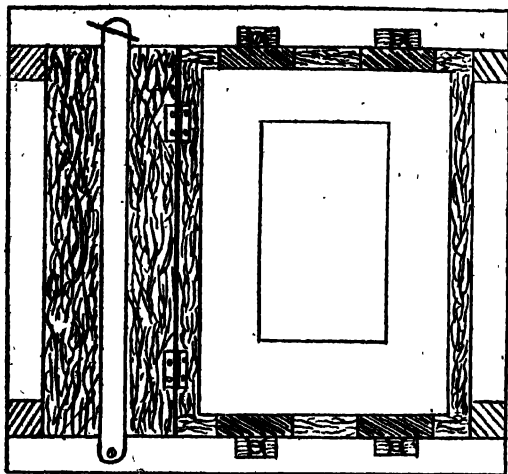


Fig. 1.

to say, space sufficient for the printing of the portrait. This frame is easily adapted from an ordinary printing frame, and without interfering with its usefulness for ordinary work. The frame should be one of the "two-thirds'-view" variety. A 12 by 10 frame will

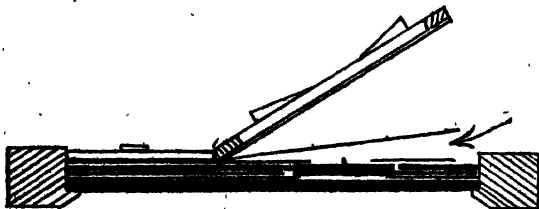


Fig. 2.

do for prints up to 10 by 8. The larger "half" of the back has a square hole cut out of it so as to leave a frame of 1 in. in width. A 10 by 8 piece of glass is fixed under this, with a few touches of glue and a piece of cardboard under the other side to make things level. The spring for the glazed half can be removed, and in its stead

four turn-buttons are screwed to the frame and four small wedges are glued to the back, as shown in Figs. 1 and 2. A sheet of glass is used in the frame. In the description of the remaining parts of this device reference is made, for convenience sake, to the 10 by 8 portion of the frame only, the remaining part (on the left-hand in the drawing) merely serving as a clamp to keep all the parts together without slipping, and it will be understood that on each mask, etc., described a piece is left on the left side some 3 ins. wide in order that it can be so clamped.

On top of the glass are two thicknesses of thin cardboard cut rather smaller than the frame, and with openings rather too large for the negatives they are intended to hold. A supply of these carriers of various thicknesses should be made so that the thickness of any negative can be matched accurately. By using two of these card masks to the level of the film it is easy to clamp the negative by sliding the cards in opposite directions for a fraction of an inch. Above this comes the border printer itself, which is a folder consisting of two parts, the mask below and a film border negative above, which, being stuck together by the extension pieces on the left-hand side, as before mentioned, are always in exact register.

To make this, one sheet of opaque paper 12 by 10 is required. In it is cut the desired opening in an appropriate position in the 10 by 8 portion. A further part of the outfit is a 12 by 10 piece of translucent material, such as matt celluloid or gelatine sheet, or even tracing paper or cloth. The latter is not so good, as it prolongs the exposure, and is uneven in texture. Whatever material is used is stuck securely to the mask on the left side, and when dry a fine pencil line is ruled on it just a little outside the edges of the mask, which can be plainly seen on laying the whole on a sheet of white paper. This centre is then filled up on the material, first with a ruling pen and then with a brush charged with opaque. Very thin paper may be used instead of paint if care is used to cut it accurately; but it should be attached only by a spot or two of adhesive, as either paste or dry-mounting will cause cockling and will spoil the register. The outside margin is then built up to a border negative with pieces of thin film tissue, or, preferably, the tints should be put on with an air-brush, so as to keep the thickness equal all over.

The frame is used as follows:—The negative is laid in one of the card-carriers, and another one added to come level with the film. On this place the mask, and centre the subject in the aperture while bending back the border film. Having adjusted things satisfactorily, put in the back of the frame and clamp the narrow left-hand portion, which will then hold everything securely in position. To print, the glazed back is lifted, also the border film, the bromide paper placed on the mask under the border negative, which is then allowed to fall on to the back of the paper (Fig. 2). The frame is closed and tightened up by means of the turn-buttons. The print is then exposed in the ordinary way, and for the border the frame is turned round and the design printed through the back. The bromide paper is then taken out, and the remaining prints made without shifting the mask. It is obvious that any depth of border

can be got by this method quite irrespective of the density of the individual negatives. The amount of grain given by printing through the paper will not be objectionable, as a rule, if a well-diffused light be used for printing, and the borders will not be quite sharply defined; but, within its limitations, this method is capable of some very useful results, and it is a very quick and certain one in use. There is no reason why the photographer's name and address should not be very easily and effectively introduced, to print in white letters, with any tinted border.—"B.J.," Mar. 31, 1916, p. 191.

Control in Bromide Printing.—Dr. A. T. Lakin prefers the following method for obtaining variations in the contrast of prints. The exposure is judged as nearly as can be by the eye from the appearance of the negative, rather less than more the judged exposure being given. The print is soaked in water before developing in:—

A.—Aduroil	3 drms.
Sodium sulphite	3 oz.
Water	19 oz.
B.—Potassium carbonate	2½ oz.
Water	19 oz.

Equal parts of A, B, and water are taken, and to each ounce of developer 1 drms. of a 10 per cent. solution of potassium bromide is added. The print is developed with this until the shadows are as dense as desired (judge the density by looking through the print, not on its surface). When this stage is reached, the developer is poured off and the print flooded with water for the purpose of examination.

Sometimes this treatment is sufficient, but if the details in the shadows are not developed as far as wished, one can apply a fresh developer of ten drops of Azol to 4 ozs. of water, and leave the print in this until the shadow details attain the required strength. In this way one can get any desired effect from light to dark, from a flat print to one with strong contrasts, the exposure being of no great account, providing one does not get extremes of under or over-exposure. Under-exposure simply requires a longer development; over-exposure a shorter one.

The final colour of the print is the only possible cause for complaint, and this can be easily remedied by after-processes.—"American Annual of Photography," 1916, p. 268; "A.P.," Dec. 27, 1915, p. 515.

Soft Bromides from Hard Negatives.—A contributor to "Assistants' Notes" in the "British Journal" recommends the following special developer for bromide prints from negatives which are somewhat over-developed:—

A. Diamidophenol	120 grs.
Sodium sulphite	2 ozs.
Sulphuric acid (strong)	30 drops
Water	10 ozs.
B. Sodium carbonate	1 oz.
Water	10 ozs.

The proportions of soda solution (B) can be varied to suit the negative; the harder it is the more soda may be used, but the developer will soon discolour if much of the soda is added. This developer should be diluted to suit the negative: the more water, the softer the print; it may be used very dilute.

The exposure will be found to be very short. A negative needing an exposure of 30 seconds for a normal developer will, perhaps, require only five seconds with this one. It will, of course, be noted that it contains no bromide. The image usually appears very quickly and total development is very short, sometimes not more than a minute before the print is sufficiently developed. The rapidity of development makes it difficult to handle a number of prints at once, but dilution of the developer greatly reduces its speed. One would expect that such rapid development would give prints of poor colour—a rusty black, for instance—but the colour is a good cold black in the shadows, with silvery grey lights. The print, however, does not seem to tone very well with sulphide, as the whites become very yellow, probably due to the shortness of the exposure and development without bromide. They might tone by the hot hypo-alum process, but the colour would probably be rather cold.

The stock solution (A) will not keep very long, and as it may be regarded as an emergency developer only it is best to make it up in small quantities from time to time when required. It may be thought that so rapid a developer would be beyond control when a number of prints are wanted alike, but by using the developer considerably diluted the speed is reduced, and if only a small number of prints are put into the developing dish at one time it is not difficult to secure uniformity.—“B.J.,” Aug. 25, 1916, p. 473.

Two Causes of Stain.—Brown stains on development prints have been found to be due to handling prints (in removing them from the fixing bath) with fingers which had just been occupied in toning and had slight traces of sulphide on them. The hypo was not very fresh, and, therefore, contained a good deal of soluble hyposulphite of silver. The slight trace of sulphide converted some of this soluble silver salt (retained in the film) into insoluble silver sulphide, thus staining the emulsion brown. This was proved by purposely staining half of a print in this way, while the other half would not stain at all after quite a brief rinse, showing that the discolouration was not due to incomplete fixation.

Another stain trouble which at first defied explanation occurred at only one end of some whole-plate card bromide. Even when a sheet was cut up it still became stained at that particular part of the paper. The marks were eventually found to be due to one end of the packet having been near a source of heat and so having contracted a curl just at that end. On fixing the prints, very likely in an overcrowded and overworked bath and most probably put in face upwards, this particular end did not get the thorough immersion in the hypo that development papers need, especially during the first few moments. The end curled up out of the solution until the sheet became limp, and so traces of developer, retained in the film, became oxidised.—“B.J.,” April 28, 1916, p. 156.

GASLIGHT PAPERS.

Pyro Developers for Cyko Gaslight Papers.—The Ansco Company give the following formulæ for developers suitable for their Cyko papers:—

A—Pyro	75 grs.
Glacial acetic acid	2 drops
Potassium metabisulphite	7 grs.
Sodium sulphite	260 grs.
Water	16 ozs.
B—Sodium carbonate	300 grs.
Water	16 ozs.
Potassium bromide 10 per cent. solution	3 to 4 drops.

For use take equal quantities of A and B. This developer works very well, the colour and gradation being good. It develops in about one minute, and the stain produced is very slight.

The second formula is as follows:—

A—Pyro	180 grs.
Sodium sulphite	3 ozs.
Potassium ferrocyanide	30 grs.
Water	16 ozs.
B—Sodium hydrate	60 grs.
Water	16 ozs.

For use: A 1 part, B 1 part, water 2 parts, plus 3 drops of saturated potassium bromide to every 14 ozs. of developer. The above developer has incorporated with it an agent that takes up the oxidation products—i.e., potassium ferrocyanide. The introduction of this agent has reduced staining and oxidation of the developer to a minimum. The colour of the prints is splendid; gradation fine, and the developer may be used repeatedly without staining or reducing its speed of development, which is about 1 to 1½ minutes. The sepia obtained are beautiful.

This developer may be modified when necessary. When diluted to half strength it produces softer results, without in any way destroying the beauty of the print.—“B.J.,” (from “Portrait”), May 12, 1916, p. 282.

Acid Short Stop for Gaslight Papers.—An acid bath consisting of one ounce of glacial acetic acid in a winchester of water is very useful in gaslight printing. Prints may be placed in it direct from the developer and may be left in it some time without fear of stains, while it checks development instantly. Sometimes prints put into the hypo without having the developer washed off sufficiently, in cases of very quick development, will show dark streaks which cannot be removed. The acid bath entirely prevents this, and there is not the same danger if traces get into the developer from the fingers as in the case of hypo. It is advisable to rinse prints between the acid and hypo baths, but if potassium metabisulphite be substituted for the acetic acid this is not necessary.—“B.J.,” August 4, 1916, p. 433.

Toning Bromide and Gaslight Prints.

SULPHIDE TONING.

Cheaper Bleach for Sulphide Toning.—Owing to the phenomenal increase in the cost of potassium bromide, and to a lesser extent of potassium ferricyanide, various formulæ for cheaper bleaching solutions have been suggested as substitutes for the customary mixture of ferricyanide and bromide.

R. L. Boyd recommends the two following, which are made up without bromide, and yield results exactly similar to those with the regular formula:—

Potass ferricyanide	120 grs.
Liq. ammonia .880	$\frac{1}{4}$ oz.
Water	10 ozs.

Potass ferricyanide	120 grs.
Soda phosphate	$\frac{1}{2}$ oz.
Water	10 ozs.

The soda phosphate in the second formula is the disodium hydrogen phosphate usually supplied by chemists when "soda phosphate" is ordered.—"B.J.," Feb. 11, 1916, p. 91.

The much lower cost of a bleacher composed of permanganate, sulphuric acid, and salt is emphasised by T. H. Greenall, by whom this bleaching formula was introduced some years ago ("B.J.A.," 1914, p. 655). He calculates that a permanganate bleach will do the work of a ferricyanide-bromide solution costing twenty times as much, whilst, as regards the results and the manipulation, the permanganate method possesses certain positive advantages.—"B.J.," Feb. 18, 1916, p. 106.

T. H. Greenall, writing in regard to the permanganate bleach formula worked out by him, gives the following hints on its use:—

1. The permanganate must be kept in solution separately from the other ingredients with which it is to be mixed at the time of using.

2. The formula with sulphuric acid is drawn up for sulphuric acid containing 96 per cent. of real acid, and of sp. gr. 1.8—that is, 8 fluid ozs. should weigh practically 1 lb. avoirdupois. A weaker acid might, of course, be used, but more would be required. It is, however, important that the actual amount of pure acid present should not exceed that given in the formula, unless at the same time the amount of salt is increased. For those who have no chemical knowledge the formula with hydrochloric acid (see "Formulæ" section of this "Almanac") is the simpler.

3. When required to bleach a batch of prints, a given quantity of the mixed solution must be allowed for each print. Thus, if one print requires 2 ozs., 24 ozs. must be taken for twelve prints, and *thrown away after use.*

4. If the prints are properly exposed to the action of the bleacher, they should bleach completely in from $1\frac{1}{2}$ to 2 minutes. If a print is slow in bleaching, this may be due either to lack of strength in the acid (see paragraph 2 above) or to the presence of hypos in the print.

5. The author has stated that a print might be taken straight from the fixing, bleached and sulphided, and yield a result identical in all respects with that from a fully-washed similar print. That is quite true, but it is not to be recommended, because for every ounce of fixing bath left in the prints probably about a gallon of bleaching solution would have to be used up before the print would begin to bleach. All that it is intended to show is that traces of hypo left in the print make, with this bleacher, no difference in the final result.

6. As the presence of hypo delays bleaching, it is obvious that when it is desired to get intermediate tones by allowing the bleacher to act only for a limited time, the prints must be quite hypo-free, or the worker will have no control.

7. The strength of the sulphide solution should not exceed one grain to the ounce. Finally, after sulphiding, the prints should be cleared by passing through a bath of oxalic acid, about 5 grains to the ounce, which may be used over and over again.

Some further notes are as follow:—

Intractable stains may arise should particles of undissolved permanganate come in contact with the print. Permanganate is a heavy salt, and rather slow in dissolving in cold water, whilst the strong coloration it gives may lead to the idea that it is dissolved when such is not the case. In hot water it is more quickly dissolved, and there does not appear to be any objection to making up the stock solution with water heated nearly to boiling. This solution will keep a year or two, and, in any case, specks of undissolved substance could be readily detected on looking through the diluted solution, which should be clear.

There is, however, another cause of stains, which may arise through the use of metallic dishes. If a print saturated with acid, such as the acidified permanganate, comes in contact with lead, copper, or iron, a certain amount of the metal is absorbed by the print, and will give rise to a sulphide stain on sulphiding. The lead gives a dark brown or black, the copper a ruddy brown, the iron a blue-black. The copper and lead stains are indelible; the iron readily yields to treatment with a plain solution of oxalic acid. It is, therefore, highly important not to lay the prints whilst in an acid condition in contact with these metals, nor should the prints at any stage be allowed to come in contact with metallic solutions—i.e., of the heavy metals.

A town's soft water, which has stood in the lead pipes or in a lead cistern for some time, should never be used when sulphide-toning, whatever bleaching reagent may be employed, as its use must inevitably more or less degrade the whites of the print. This is seen by the dark brown coloration which it gives when mixed with a little of the sodium sulphide. Another source of contamination with lead is lead paint or bath enamel or white lead, which might be used in the making of a dish for temporary use, and which would be unsuited for this purpose. Enamelled iron is quite safe, but any flaws in the enamel should be made good with acid-proof varnish.—"B.J.," Mar. 31, 1916, p. 203

Warm Tones by Bleaching and Slow Redevelopment.—The following method is recommended by the Kodak Company for the production of sepia to brown-black tones on Kodura slow bromide paper. The principle of the method is the bleaching of the prints to form an image in silver bromide and their redevelopment in a much diluted solution. In the course of the slow redevelopment the image gradually passes from red through sepia to purplish.

The Kodura prints are developed, fixed, and washed in the usual way. They are next bleached in any ordinary ferricyanide bleacher, and then washed to remove the yellow stain, after which they are ready for redevelopment.

REDEVELOPER.

Normal Kodura developer (without bromide)	1 oz.
Water	15 ozs.

This is a weak developer; it should not be used for too many prints, nor for more than one batch.

The image will redevelop gradually, and will first appear of a red colour. For a rich, cool sepia, the redevelopment should be allowed to proceed until the last trace of red has disappeared from the shadows, and the image has a faint purplish tinge. The extent of the redevelopment determines the tone—the longer the action the colder will be the tone of the finished print. This makes it possible to obtain any desired tone. The redevelopment is quicker towards the end, and the prints must be taken out at the right point. When large batches of prints are dealt with, it is well to check the action of the developer by means of a stop bath.

STOP BATH.

Glacial acetic acid	$\frac{1}{2}$ oz.
Water	40 ozs.

The prints are rinsed in this and then washed for a few minutes. They are next transferred to the sulphide bath in which the toning is completed. A final washing completes the operation. The following points should be carefully noted:—

1. It is essential that the bleaching and redeveloping should be done in artificial (white) light, and not in daylight.
2. To obtain perfect uniformity in a batch of prints from one negative, it is necessary that they should be evenly developed and all redeveloped to the same extent.

After a few experiments, and becoming familiar with the appearance of the redeveloped image in its various stages, the process becomes perfectly easy and certain.—“Professional Photographer,” Mar., 1916; “B.J.,” Mar. 24, 1916, p. 173.

Alternative Sulphide-Toning Methods.—The unsatisfactory results as regards colour and depth which are produced if the original black bromide is not of sufficient “body” (usually the result of too rapid development) has no doubt prompted the recommendations of formulæ and methods somewhat different from the customary two baths of ferricyanide-bromide and soda sulphide. One of these alternatives is the addition of a mercury salt to the

bleacher, not a very desirable addition as regards permanency. Another method is to bleach the print only partially, leaving a certain amount of unaltered silver to reinforce the silver sulphide produced by the toning process. This again is not a very desirable method, since it is almost impossible to carry out partial bleaching proportionately throughout the image.

Another method is to sulphide the image directly by means of liver of sulphur, this process having the advantage of coming to a stop before the whole of the black silver image has been converted into sulphide. Papers, however, differ considerably as regards their suitability for this method.

Another plan is to bleach completely but to sulphide partially, completing the treatment of the bleached image with a developer which reconverts into black deposit the bleached image left unaffected by the sulphide bath. Here again it is almost impossible to stop the sulphiding action at the required point, and though other workers have recommended the use of a mixed bath of sulphide and developer, the process has not been adopted at all generally.

A method which on general grounds appears to be better than any of these is to bleach the image fully, to develop partially, and then to sulphide the remaining silver salt (bleached image). This process has the advantage that development can be regulated to a nicety, and the tone is under control according to the degree to which the development is taken before applying the sulphide bath. This control is exercised by rendering the developer slow in action simply by diluting it with water or by restraining it considerably with bromide. It is usually found that this method, which is that described in the preceding paragraph for Kodura paper, tends to yield results possessing rather more pluck and contrast than those obtained by the regular process of bleaching and sulphiding.—“B.J.,” April 14, 1916, p. 218.

Properties of Bleaching Solutions.—A solution which bleaches the silver image on a negative or print is necessarily an oxidising substance. The various bleaching baths which can be employed in the toning of prints and intensification of negatives, etc., differ according to the oxidising substance employed, this difference hingeing largely on the nature of the silver compound produced by the action of the oxidising substance upon the silver image. Some oxidising agents produce a soluble compound, and therefore require to be used in admixture with plenty of bromide. The soluble compound is then immediately converted into insoluble silver bromide before it has had time to diffuse away from the image. Two bleaching agents which produce such soluble silver compounds are chromic acid (which converts the image into silver chromate, which is soluble in the chromic acid solution) and ammonium persulphate, which produces soluble silver sulphate.

On the other hand, potassium ferricyanide produces the insoluble silver ferrocyanide, and thus can be used alone as a bleaching agent. It can be followed by a solution of potassium bromide, but it is better to use the two in the one solution for the reason that

ferricyanide alone is very much slower in action, owing to the fact that silver ferrocyanide in a moist state is a very glutinous substance which is almost impermeable by solutions. Thus the upper layer of silver ferrocyanide which is formed opposes the further action of the ferricyanide, but in the case of a ferricyanide-bromide bath the silver is converted into silver bromide, and the action therefore goes on more quickly. Also for reasons which are not clearly understood the tone of prints bleached in the mixture is usually better than that of those toned in a plain solution of ferricyanide.

Bleachers differ not only as regards their speed, but as regards the susceptibility of the bleached image to re-development without exposure to light. A bleached image consisting of pure silver bromide is undevelopable unless exposed to light. The only bleachers which yield an image of this kind are solutions of bromine and chlorine. Bleached images produced with ferricyanide and bromide can be redeveloped without exposure, and so can those obtained with a mixture of chromic acid and bromide or potassium bichromate and hydrochloric acid. These do contain a little free bromine and chlorine respectively, but nevertheless can be developed without further exposure.

A solution of ferric chloride (perchloride of iron) yields a bleached image consisting of silver chloride, containing traces of iron compounds. Also copper bromide and copper chloride are bleachers, yielding respectively silver bromide and silver chloride with traces (apparently) of copper. As a rule, bleached images consisting of silver chloride can be "printed out" by exposure to strong light yielding tones which are very suitable for lantern transparencies.

A bleached image consisting of silver chloride can be readily converted into one of bromide or iodide by immersion in potass bromide or iodide solution. Similarly, a bromide image can be converted into one of iodide by treating with potassium iodide, but an iodide image cannot be converted into bromide or chloride, nor a bromide image into one of chloride, by similar means. Moreover, the conversion of a chloride image into one of bromide or iodide, or of a bromide image into one of iodide is never quite complete: there always remains a little of the original silver compound (chloride or bromide) of which the image consisted at the start. The difference is not usually sufficient to affect the result of re-development or application of a sulphide bath, although it does effect the result of "printing out."—"B.J.," Oct. 22, 1915, p. 682.

R. E. Crowther, in reference to the above, points out with the exception of the ferricyanide-bromide bleacher and possibly also the iodine bleacher, all those just referred to exert a distinct action upon the gelatine. Bichromate and persulphate exert a tanning action, and hence in the use of a bichromate bleacher complete removal of the bichromate is of importance. If not removed, traces of bichromate are liable to exert an oxidising action on the sulphide used for sepia toning, producing a certain amount of hypo which is a solvent of the bleached image, and thus leads to destruction of the lighter tones as also to unpleasant colour and dichroic deposit or sheen in the finished prints.

He has found that the ferricyanide-bromide bleaching bath may be revived by adding about 10 grains of potass. bichromate to every 20 ozs. of bleacher which is becoming exhausted as shown by its slow bleaching action. When addition of the bichromate ceases to produce any noticeable quickening of the bleacher, it is an indication that more bromide is required.—“B.J.,” Oct. 29, 1915, p. 709.

J. Goulding mentions that sodium hydrosulphite (NaHSO_3) will re-develop an iodide image after exposure to light. Daylight is best for this exposure, but prints have been successfully re-developed after a short exposure to incandescent gaslight. The hydrosulphite, however, is not a pleasant re-developer owing to its pungent odour.—“B.J.,” Nov. 5, 1915, p. 726.

The Quinone Bleacher.—J. Goulding contributes some notes on the properties and use of quinone in admixture with bromide or an acid as a bleacher for negatives or prints.

A solution of quinone, in conjunction with, say, potass. bromide, acts upon the image on plate or print in the direction of altering the colour from the original black, through purplish-brown tones to a point of equilibrium where the result is a reddish, flesh-coloured image, muddy and thickened in appearance when examined by transmitted light. The image is, however, quite substantial, and is not “bleached out” as usually understood. It is open to after-treatment by re-development, by ammonia, by sulphites, or it may be sulphided, with varying results, which need not be dwelt upon here beyond the remark that the final colour after sulphiding is never quite so warm or fiery as when a fully bleached out image is treated. This is sometimes an advantage.

If quinone is used with an alkaline chloride the silver image is attacked much more slowly, and in some cases there is no visible change, although if a sulphide solution is then applied the colour will usually tend towards a warm black, indicating that there has been a certain effect.

If potass. iodide is substituted for the bromide the action becomes more energetic and goes further, although even yet the point of equilibrium stops short of bleaching out.

But if, in place of the haloid salts, we use quinone in acid solution we have definite bleachers. With hydrochloric acid we get a clean chloride image readily amenable to any of the usual methods of after-treatment. As might be expected, there is sometimes a tendency to lose detail in the high-lights. On occasion this tendency may, of course, be made use of.

Quinone and hydrobromic acid act in a most satisfactory manner, and give a stainless, bleached-out bromide image which can be further treated in any way according to the result desired. Re-developed, there is no intensification, but the colour of the image is generally improved in quality. Obviously there has been no addition of metal other than silver to the image.

Sent out by the Lumière firm as their “Quinochrome” toner, the quinone substance is in the form of a yellow impalpable

powder, which is repellent of water, and obstinately insists on floating on the surface of the liquid. An easy way of bringing it into solution is first to moisten the powder with a small quantity of acetone. Quinone also occurs in small yellow crystals, which are easier to deal with. The solutions made up with alkali haloid salts do not keep well. The chloride mixture is worst, and the iodide the best, in this respect. The acid solutions keep much better; they darken to a deep port wine colour, but remain clear, and may often be used some days after mixing. It is, however, best to keep quinone in 10 per cent. solution in acetone, which keeps indefinitely. By taking from this a few drops to each ounce of water, and adding potass. bromide or potass. iodide from 10 per cent. solutions, or hydrochloric or hydrobromic acid from the stock bottles, any solution to meet the requirements of the moment may be made up at once.

The advantages of quinone lie in its adaptability and the readiness with which it may be used in different ways, and more especially in the fact that, notwithstanding the tanning action on the gelatine, which is perhaps even more pronounced than with the bichromate or persulphate solutions, there is complete freedom from any tendency to stain, a consideration of value in dealing with such work as lantern slides. Against quinone is the high price; at present, owing to the war, it is practically unobtainable. —“B.J.,” Nov. 5, 1915, p. 725.

The Carbon Process.

Varnished Carbon Prints.—An old method of protecting carbon prints to a degree which renders them as durable as japanned goods and practically as permanent as fired enamels is as follows:—The carbon print is first mounted with glue upon a wooden panel or transferred directly to the surface of the wood. It is treated with a thin coating of chrome alum gelatine to fill any breaks in the surface. When dry it is taken into a warm room and given a coat of the best pale copal varnish. When quite dry and hard a second and third coating are given, each taking quite three days to dry. When thoroughly hard, the surface is rubbed down until quite even and free from brush marks, etc., with wet pumice powder applied with a cork rubber. Two more coats of varnish, followed by another rubbing down, should leave a perfectly even surface, which has to be polished to a mirror-like surface with rotten-stone and oil.—“B.J.,” Jan. 14, 1916, p. 18.

The Bromoil Process.

Soaping Bromoils for Inking Up.—“Experientia” recommends as a certain means of giving the bleached surface of the bromide print just the proper attraction for the ink the rubbing of the surface of the print with a lather of soap. The print is placed in a dish of water at about 70° F. A bar of ordinary Primrose

household soap is rubbed on the hands so as to get a good lather, and this is then rubbed well on to the surface of the print while it is soaking in the water at 70° F. A final wash is given at the same temperature, and the print may be placed on the base for pigmenting. It is surface dried, and will ink up readily, no matter what developer has been used.—“Phot.,” Jan. 11, 1916, p. 23.

Controlled Bromoil-Transfer.—J. H. Coatsworth has given working details of the procedure which he adopts in working the Bromoil-transfer process so as to control the transference of the pigment from the inked bromide to the transfer paper. Broadly, his method consists in first tracing upon the back of the bromide print the outlines of the subject, these latter serving as a guide when applying pressure to the pigmented print when the surface of the latter is laid upon the transfer paper. The outline is easily traced on the back of the bromide print by laying the print against a window-pane, when the subject can be sufficiently seen on the back to allow of its general shape and masses being pencilled in.

In order that the process shall be successful it is necessary to take certain precautions to secure the correct degree of swelling of the gelatine coating of the bleached print. Using the Sinclair bleacher at the normal temperature, the print is next washed in several changes of water, then left in a dish of water to swell.

It need not be fixed, but is next placed in warm water until a sufficient degree of relief is seen to be obtained as can best be judged by the line separating the image from its white margin. For inking, the medium used for softening the pigment should be one of the slow-drying variety, such as that sold by Sinclair for Bromoil, and inking should be done as quickly as possible.

The print is prepared for the special localised form of transfer as follows:—It is first laid on a piece of clean glass and trimmed down to size. Pencil lines should have been drawn on the original bromide to serve as a guide for trimming. It is then lifted up with a clean palette knife and laid face up on thick blotting-paper. The dry transfer paper is placed on it and gently pressed down to ensure a perfect contact all over. The whole packet is then reversed (so that the blotting-paper comes uppermost) and placed on a piece of smooth card, or better still, on a wooden drawing-board, the surface of which must be perfectly even. The blotting-paper is now removed and replaced by a sheet of strong tracing paper, that should be transparent enough to let the pencil outline of the image, drawn on the back of the print, appear clearly through it. On the top edge of the tracing paper—but at some distance from the pigmented bromide—is placed a heavy weight of some sort, such as a large book, to prevent any possible slipping of one paper on the other. Now comes the transference of the pigment to the paper, which is done by using any tool without sharp edges. A very suitable instrument is the small boxwood “boaster” used by sculptors for plaster modelling. Guided by the tracing on the back of the print, the “boaster” is rubbed

vigorously on the tracing paper. The pressure must be heavier in the shadow parts, in order to get plenty of ink on to the transfer paper. Sketch effects can be produced on portrait pictures by this means, the progress of the work being readily examined by lifting up one corner of the tracing and bromide paper, whilst holding down the opposite side of the latter to maintain it in register with the transfer paper.—“A.P.,” Nov. 29, 1915, p. 431.

Rollers for Pigmenting.—A German worker, Wurm-Reitmayer, has given the following method for making rollers for the purpose of inking up oil or Bromoil prints:—

A glue roller of the required size should be purchased and also some furniture plush with as long hair and of as good as possible quality. To prevent the hair or threads from coming loose, make a solution of

Orange shellac	70 to 75 gms.*
Alcohol	100 c.c.s.

by gently warming. Paint this on the back of the plush with a round, stiff, hoghair brush, using the solution freely but not so that it will penetrate through; hang up to dry for twenty-four hours. The roller should be removed from the handle and should be wrapped round with felt of from 3 to 5 mm. thickness, taking care to avoid wrinkles. Over this should be stretched some stout paper which has been soaked in water. When dry the paper should be painted over with fish-glue and the felt, cut into broad strips, wound spirally round the glued paper, taking care that the edges meet and do not overlap. In about twenty-four hours the roller will be dry and ready for use.—“Atelier,” 1915, p. 90. (from “Wilson’s”), Feb., 1916, p. 79.

Iron Printing Processes.

(Other than platinum.)

Kallitype Process.—N. C. Hawks, a veteran worker of the Kallitype process in the United States, recommends the following sensitizer:—

Water	4 ozs.
Ferric oxalate	400 grs.
Potassium oxalate	100 grs.
Silver nitrate	100 grs.

This should be filtered through fine linen and spread with a Blanchard brush.

The water must be free from chlorides (e.g., common salt). The amount of oxalate of potassium and nitrate of silver may be reduced to 90 grains each, but equal amounts should be used.

The developer is compounded as follows:—

Water (hot)	18 ozs.
Borax (powdered)	1 oz.
Sodium tartrate	1½ oz.

Dissolve the borax first, and when the solution is partially cooled,

add the tartrate of soda. Rochelle salts may be substituted for the latter if desired. To use, take 4 ozs. of the above and add one-half drachm of a 2 per cent. solution of bichromate of potassium. While the above gives a rich, velvety-black, the tone may be made warmer, through all the shades of brown, by simply reducing the quantity of borax used; the less borax, the lighter brown.

Printing is the most difficult part of the process, but is easily acquired by a little practice. Expose to direct sunlight, and, as soon as the outlines only of the shadows are visible, the print is ready for development.

Development—The best way is to use two trays of developer—No. 1 to contain the normal amount of restrainer, viz., one-half drachm bichromate solution to 4 ozs. of developer; No. 2 to have but two or three drops to 4 ozs. of developer. After exposure, place the print in No. 1 for three seconds only, watching closely to see if the half-tones come up properly. If they do, leave the print in the No. 1 tray, rocking gently till image is fully out. If not, and the print shows too much contrast, transfer it as quickly as possible to No. 2, which will bring up the half-tones and detail. Just as soon as these are fully up, place the print back in No. 1 and leave it there for five minutes to clear the whites.

After prints are fully developed, rinse them two minutes and place in:—water, 32 ozs.; stronger ammonia, 2 drachms, for ten minutes. When many prints are to be fixed, it is well to change occasionally from the old bath to a fresh one.

After fixing, wash the prints in five or six changes of water, and then dry between blotters in the usual way.

The prints can be mounted either wet or dry, as they remain flat after drying and will not curl.

To convert a Kallitype into a pure platinum, develop in the usual way, and then, after washing about half a minute in clear water, immerse in the following bath:—

Water	36 ozs.
Chloroplatinite of potassium	15 grs.
Common salt	150 grs.
Citric acid	150 grs.

Rock the tray until the proper platinum tone is obtained. Then rinse well and fix ten minutes in:—Water, 32 ozs.; stronger ammonia, 3 drachms, then washing as usual.

Causes of Failures and their Remedies. Weak prints, under-exposed; print a few seconds longer. Bronzed prints, over-exposed; the platinum bath will correct this. Too dark prints, over-exposed; tone in the platinum bath. Impure whites, insufficient restrainer; add more.—"Cam. Craft," July, 1916, p. 263; "B.J.," July 28, 1916, p. 415.

Home-made Ferricyanide.—The United States Department of Agriculture, as the result of the greatly increased price of ferricyanide, has worked out and described in detail a method of producing a solution of ferricyanide suitable for the manufacture of blue-print paper. Chlorine gas from a cylinder is passed through a solution of potassium ferrocyanide 1.33 lbs., dissolved in about

2½ quarts of distilled water. The gas is passed for some time after the colour has darkened considerably, after which it is necessary to draw off small portions of the liquor and test with ferric chloride. As long as a blue precipitate is produced, treatment with the gas must be continued. The product is 1 lb. of potassium ferricyanide, about ½ lb. of chlorine being required.—“B.J.,” May 12, 1916, p. 281.

Trimming, Mounting, and Framing Prints.

Cutting Prints to Exact Size with a Trimming Desk.—G. Wilson describes a system of marking prints in order to secure uniformity in the size of the prints and the placing of the subject upon each when using one of the desk trimmers. The system consists in the use of a sheet of, preferably, celluloid marked with a series of rectangles representing various desired sizes of the trimmed prints. Although celluloid is the best material, opaque sheets such as card-

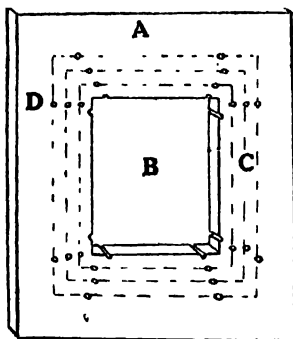


Fig. 1.

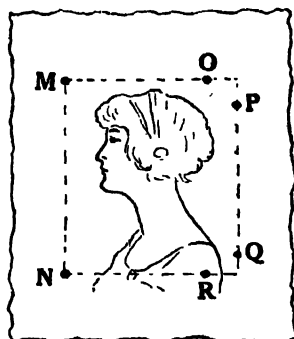


Fig. 2.

board, millboard, or fret-wood can be used, though with less advantage since the picture cannot be fully seen when laying the board upon the print.

In the case of a celluloid sheet a minute hole is pricked a little way from each corner of each rectangular mark, as shown in Fig. 1. In the case of a cardboard sheet a strictly rectangular aperture is cut as shown in Fig. 2.

In use, the celluloid sheet is laid on the print and adjusted in position so that the picture comes as it is required within one or other of the rectangular spaces. The print is then quickly given, eight fine marks with a pin or a fine-pointed pencil passed through the eight holes. The object of having the holes not at the corners, but a little way from each is to avoid trimming off the mark on the print when making a cut with the trimming desk.

In the case of the opaque mask (Fig. 2) the marks are made with

a few touches of a finely pointed pencil at points such as O, P, Q, and A, not at M or N, which are included in the drawing only to show the wrong position of the marking. When marked in this way the prints can be quickly and accurately trimmed with any pattern of the guillotine trimmer.—“B.J.,” Feb. 18, 1916, p. 106.

Double-Speed Work in Dry-Mounting.—F. J. Wadey recommends the following procedure for getting through double the normal amount of work in the use of a dry-mounting machine:—

Two pieces of blotting-paper, preferably Robosal, are required, and a piece of the thinnest cardboard, the same size as the zinc plates. It is advisable to dry each piece of Robosal separately and then together by placing them in the machine and screwing the press down as tightly as possible.

Upon withdrawal, wipe the moisture off the plates with a dry cloth to avoid risk of the prints sticking. Then place one piece of Robosal on the plate, and on this (say the plates are about 15 x 12 size) place, according to the size of the mounts, two or three cabinets, or their equivalent, face down, covering them with a piece of cardboard, and laying on this, say, a whole-plate or four C.d.V. prints. The second piece of Robosal is placed on top, and then the other plate, the whole being inserted in the machine and the press screwed down in the usual way.

The bench being raised to the opening of the machine, or some kind of a raised platform devised, the plates are drawn out and, with a firm grip at the bottom end, are turned completely over, re-inserted in the machine, and the press screwed down again. When withdrawn it will be found that all the prints have stuck as in the ordinary way. Some may, perhaps, find it difficult to turn the plates over without the prints falling out, but after a few turns there should be no difficulty.

Another advantage is that all prints, irrespective of size, shape, and thickness of the mount, can be mounted at once, providing that no two or more mounts of unequal thickness are placed on one side of the cardboard.—“B.J.,” Nov. 12, 1915, p. 737.

Shellac Mountant.—C. N. Perez has patented a cream or paste, which can be applied to the backs of photographs in order to form an adhesive coating, or may be applied to paper in order to supply an adhesive tissue. Such a cream, to be prepared cold, is as follows:—

Water	1,000 c.c.s.
White gum lac	440 gms.
Borax	80 gms.
Soda carbonate, cryst.	20 gms.
Glycerine	150 gms.
Formaldehyde	10 c.c.s.

If to be prepared hot, only 400 gms. of gum lac would be used. The formaldehyde is used only as an antiseptic; phenol, salicylic acid, etc., may be used in place of it.

In preparing the mixture, either hot or cold, the borax, soda

carbonate, glycerine, and formaldehyde are first dissolved in the water (in the order named) at about 105 deg. F., and the gum lac finally stirred in. If to be prepared cold, the receptacle is closed; and the mass stirred every four hours until complete solution has taken place—as a rule, in fifty to seventy hours, or sooner if the temperature is raised to about 90 deg. F. If made in the hot way, the receptacle is heated over a water-bath, and stirred continuously until dissolved, which will be in about half an hour. The heat is then withdrawn, and the mixture stirred until cool.

For the preparation of shellac-coated paper, to be used in the dry-mounting press, a formula is:—

Water	1,000 c.c.s.
Borax, powdered	60 grms.
White gum lac	410 grms.
Soda carbonate, cryst.	20 grms.
Glycerine	100 grms.

This is prepared by the cold method already described.—Eng. Pat., No. 9,564, 1915. "B.J.," Sept. 22, 1916, p. 521.

Dry-Mounting Panoram Prints.—When mounting prints of a subject which has been photographed in sections, very careful trimming and mounting are required in order that the joins should show as little as possible in the finished print. Even when employing the dry-mounting process there is a slight shrinking, quite enough to show a thin line of mount between the prints. This unsightly effect may be avoided as follows:—

The prints are first slightly warmed to shrink them as much as possible, then tissueed, and the print at the left-hand end of the set then taken in hand. From this a strip is trimmed from the right-hand end side at right angles to the horizon, if the picture contains one, or parallel with any upright lines, if it is an architectural subject. This print is then adjusted on to the next one, so that the subject appears properly joined up (if there is a horizon it must continue in the same straight line), and the second print is trimmed close up to the first with a knife and steel straight-edge. It helps to get a close join if both prints are cut through together at this stage. The remaining prints of the set are then matched in the same manner, but only sides which come against other prints are trimmed now, the other sides being left till later.

The next thing is to take a piece of thin, tough paper a little larger than the complete set will be, and very slightly damp it by holding it in the steam from a kettle of boiling water. The object of this is to expand it slightly, and although too much moisture will ruin the print, the amount actually required is infinitesimal. The prints are then attached to this sheet with the mounting iron in the usual way, taking care to butt each one close up to the next, and fitting the detail correctly. The whole is then given a good pressure in the moulder, and on removal it will be found that joins are scarcely visible, the slight contraction caused by the damp paper drying having drawn all the prints tightly together. The whole set can then be treated as an ordinary print as regards the remainder of the trimming and mounting process. The top and bottom will

naturally show a much neater finish than they would if trimmed separately on each section.

When the sets are of large size, and contain much detail, it is sometimes possible to cut round some of the outlines so as to dovetail each print into the next, but this is only really practicable in the case of buildings with straight sharp lines, and where there is plenty of overlap.—“B.J.,” April 28, 1916, p. 256.

Passe-Partout Framing.—In a demonstration before the Royal Photographic Society, M. Fraser Black explained the methods which he followed in framing prints in the *passe-partout* style. As regards mounting prints to be framed in this way, his custom was to attach the print to the mount by means of a dab of mountant in the centre of the top edge. There was no necessity to mount the print all over, since its contact and position were perfectly preserved by the glass and the backing board.

The best material for the backing board is millboard. It is of hard and thick substance, and, unlike cheaper material, such as strawboard, is without effect on the colour of the mount. Other materials, owing to the ammonia contained in them, are liable to affect the colour of art mounts.

After trying many makes of binding strip for holding the glass and backing-board together, Mr. Black found it best to make his own strips out of thin, tough mounting paper, using strips of width considerably greater than those which were usually sold for the purpose. It is best to cut the strips about 2 ins. in width. The next step is then to decide what width of strip is to show on the face of the glass. This width—for example, $\frac{3}{4}$ of an inch for a glass of about 12 by 10 size—is then carefully measured off at both ends of the strip and a heavy rule (straight-edge) placed against the marks. Then, with an old paper-knife, which has been filed down so that it makes a mark on the paper but does not cut the latter, the paper is pushed up all along the straight-edge so as to form an upright strip of $\frac{3}{4}$ width. This requires to be done gently; the paper must not be rubbed, otherwise it is liable to become glossy. This having been done, the straight-edge is lifted off and the paper bent fairly flat along the fold. The strip is now ready for attachment to the glass and backing-board.

The adhesive found best for this purpose is Higgin's “Vegetable Glue.” It will stick paper on to glass or metal with such firmness that it will never leave the glass unless soaked off.

In attaching the strip the glue is first applied all the way along with an ordinary mounting brush. The folded edge of the strip is then laid against the edge of the glass, rubbed down gently, and the other part brought over to the back, taking care not to pull it too hard, but to keep it fairly taut. One strip having been attached in this way, that on the opposite side is secured in the same manner. If any mountant gets on to the front of the binding strip, the best plan is to lick it off; the mountant is not unpleasant to the tongue, and the surface of the paper is not injured.

The next stage is to put on the two remaining strips and to form neat joins at the corners. Mr. Black preferred to avoid the

slightly ugly effect of pasting down one strip upon another at the corners. Instead, it is better to hold up the strip at the corner, to make a diagonal mark with a fine pencil, and then to cut off the binding strip so that they fit the marks, using a very sharp mount-cutter's knife.

For supporting the finished passe-partouts it is better to fix loops of linen tape to the back of the backing board, allowing a sufficient length for hanging, folding the tape in the middle and binding it down at both ends with strips of mount paper pasted on the back of the board with the vegetable glue. Mr. Black also showed the somewhat more elaborate frame effects which he obtained by sticking down gilt binding material to the paper edging on the glass side of the passe-partout.—"Phot. Journ.," April, 1916, p. 129; "B.J." March 10, 1916, p. 143.

Charcoal Polish for Frames.—A black surface which is very effective for frames is that known in the cabinet trade as "charcoal polish," and used only for the best cabinet work, since considerable time and care are required, although the materials for the process are cheap.

The wood should be close grained and finished off quite smooth, and be perfectly clean.

Two solutions are required—

A.—Camphor	.....	½ oz.
Water	.....	1 pint
B.—Sulphate of iron	.....	1 oz.
Nutgall	.....	1 oz.
Water	.....	1 pint

First apply a coat of the camphor solution A., and, while still warm, follow up with a coat of solution B. The two solutions will combine and penetrate the pores of the wood, resulting in an indelible stain.

When the wood is quite dry, go over the surface with a very stiff brush; the brushes used by polishers in the trade are made of very hard couch grass. It will then be ready to receive the charcoal.

Apply powdered willow charcoal, or, in fact, any light charcoal that is free from grit; stick charcoal may be used on flat surfaces, where it is convenient, rubbing it in evenly and thoroughly.

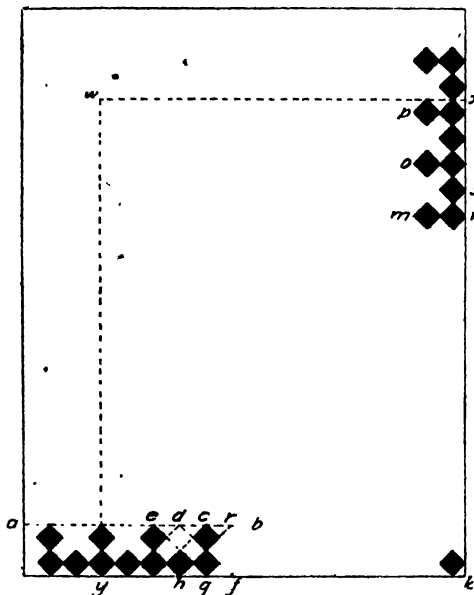
Next take a soft flannel rag and soak it well in linseed oil, adding sufficient turpentine to make it work freely; squeeze it out firmly, and go over the whole surface, rubbing evenly. Repeat this several times until the charcoal powder and the oil have penetrated the wood and the desired finish has been obtained.—"A.P.," Nov. 22, 1915, p. 416.

Enlarging.

Avoiding Grain in Enlargements from Copy Negatives.—F. A. Sinclair finds that in enlarging from a copy negative (of an original on rough-surface paper) on to bromide paper upon a

considerable scale better results are obtained, as regards absence of grain, by making a quite small copy negative. It is assumed that if this is done the grains of the rough paper of the original blend together in the small copy negative and yield a smooth surface in the enlargement.—"B.J.," July 7, 1916, p. 387.

Size Indicator for the Enlarging Easel.—C. Hague describes a fitment for the enlarging easel for the purpose of sizing up the dimensions of the projected negative image, whilst avoiding the tedious use of a graduated rule and the error liable to be made



in the dim illumination of the enlarging room. A piece of cardboard, preferably white, is cut, and a design drawn on it as shown in the diagram, using a sharp-pointed pencil. The card should first be trimmed square (to right-angles), then a line $a\ b$ drawn about 1 in. from the bottom of the card and parallel thereto. Next are laid off distances each of half an inch at the points r, c, d, e , etc., the same thing is done on the bottom at the points f, g, h , etc., and then lines are drawn from r to h , d to f , e to g , and so on. The figure having been pencilled in in this way, the blank squares which are formed are filled in with ink; a similar construction is followed along the side of the card, as shown in the upper right-hand portion of the diagram, making the points

at m and n , a certain number of inches from the corner k . Then one square is drawn in the corner k and all the lines erased except the black squares, and the scale is ready to use.

The card is used as follows:—Assuming that the focussed image on the easel covers the space w, x, k, y , the corner k of the card is placed on the corner of the image, the edge of the card coinciding with the edge of the image. Then, by counting the points of double square (as m to o) as 1 in. and the points of single square (as n to s) as half an inch, one can read at once the distance from k to x .

Thus, if the points m and n have been made, say, 7 ins. and the points c and g 5 ins. from the corner k , the edge $w x$ of the image is $9\frac{1}{2}$ ins. from k , and the edge $w y$ 7 ins. from k .

The square k in the corner is for the purpose of enabling the worker to tell easily when the measuring card begins to overlap the image. When the field of light begins to cut off the corner of the little black square, it is known at once that the card has been placed off the field, and in practical work the card will be found to avoid a very great deal of eye-strain.—“Amer. Phot.,” April, 1916, p. 209.

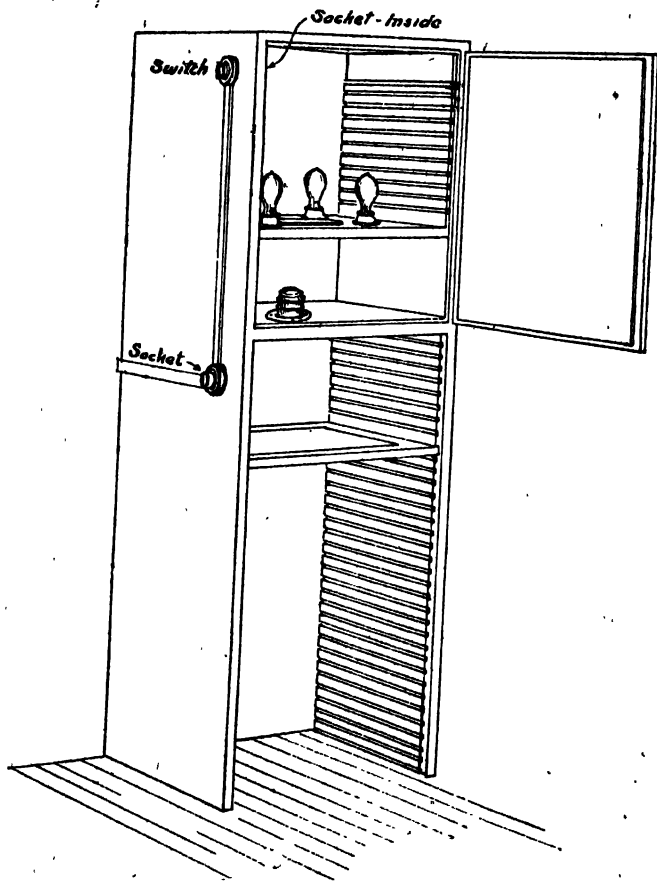
Vertical Enlarging Apparatus.—Dr. H. D’Arcy Power has described an improved form of the vertical enlarger (“B.J.A.,” 1910, p. 583), designed by him some years ago. The new model uses artificial light (from metal-filament lamps) instead of daylight, and a lens of comparatively short focus for the purpose of avoiding undue height of the enlarger. The apparatus as described serves to enlarge from $1\frac{1}{2}$ to 7 times (linear), and may equally be used for reducing from 2-3rds to 1-7th scale. It can also be employed for the direct photography of small objects, such as coins, medals, geological specimens, etc. If of the size convenient for average work, namely, to enlarge up to 16 by 20 ins., the floor space occupied is 18 by 22 ins., and the height of the apparatus 6 ft.

The enlarger consists of an upper chamber containing the lamps and a shelf, the latter to hold the negative when enlarging, or the sensitive plate when reducing. Below this is a second shelf with a lens fitted in the middle. From the level of this second shelf to the top of the apparatus a door is provided fitting light-tight to the front. The space below is provided with 48 grooves 1 inch apart, allowing of a movable shelf being placed at practically any required height by sliding it into a particular pair of grooves.

In the construction of the enlarger $\frac{1}{2}$ -inch boarding lined with brown building paper, carefully glued down, makes a light-tight job of the upper part. Particular care requires to be given to the parallelism and level of the grooves in the lower part as also to the perfect levelling of the two shelves in the upper section, since the sharpness of the enlargement throughout their area depends on this.

The illumination consists of four 100-watt concentrated filament nitrogen bulbs arranged on a square frame as shown. For the sake

of clearness, the drawing shows this board carrying the lamps in the inverted position. For enlarging from a negative it would be placed the other way up in one of the upper grooves, and the shelf



carrying the negative be fixed below these grooves. The upper compartment is lined with white blotting paper, the illumination being such that a quarter-plate negative will give a 17 by 14 enlargement on bromide paper in about 20 seconds, using $f/8$ lens.

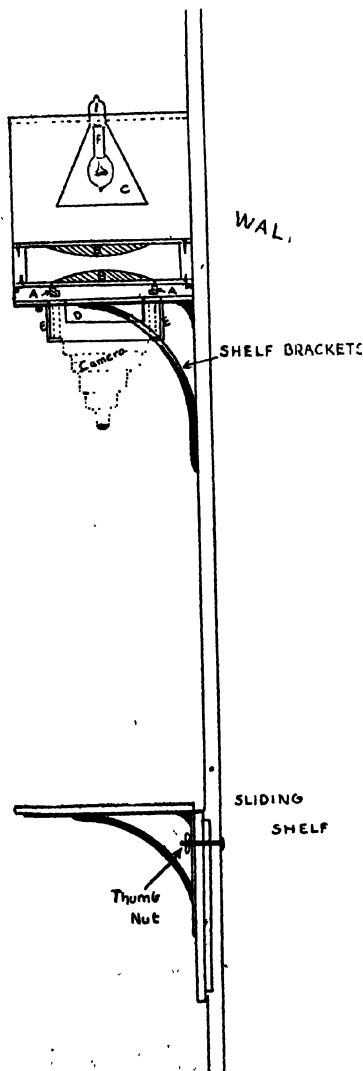
The lens, fitted to its shelf, is arranged at such a distance below the negative that an enlargement to the largest possible degree is in sharp focus on a piece of white paper placed on the lower shelf of the under compartment. For enlargements of lesser degree the lens requires to be further away from the negative, which adjustment is made by the use of a series of five rings or collars of different lengths, namely, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 inch. These screw to one another, making a total length of $2\frac{5}{8}$ ins.; used separately or in combination they provide for twenty-one different focal extensions. Each ring is marked with its length, and it is a simple matter to find by trial the length required for a given degree of enlargement or reduction, this length being then embodied in a table containing also the number of the shelf where the bromide paper requires to be in enlarging or the original when copying. Such a table is the following:—

In enlarging, the lamps, on their shelf, are placed as already stated, in the upper compartment, the degree of enlargement

<u>Lens - Six inch focus.</u> (Turned Down)		
<u>Magnification or Reduction</u>	<u>Extension Tube (in Inches)</u>	<u>Shelf Number.</u>
2	$2\frac{1}{2}$	13
$2\frac{1}{4}$	2	14
$2\frac{1}{2}$	$1\frac{3}{4}$	15
3	$1\frac{1}{2}$	16
$3\frac{1}{4}$	$1\frac{1}{4}$	17
4	1	18
5	$\frac{3}{4}$	24
6	$\frac{1}{2}$	31
<u>Lens - Three inch focus - (Turned Up).</u>		
7	LENS ALONE	17
12	$\frac{1}{8}$	24

decided on, and the lens collars and the shelf in the lower part placed in accordance with the table. For copying opaque originals the lamp shelf is placed in one or other of the grooves immediately below the lens, the other adjustments being the same as for enlarging, except, of course, that the original is laid on the shelf in the lower part and the sensitive plate placed film down on the negative shelf. A second socket is fitted to the apparatus in order to allow of the connection of the lamps when in this position. For the copying of transparencies, the lamps are placed in one of the lower grooves of the lower part; the other adjustments are the same.—"Cam. Craft," May, 1916, p. 177, "B.J.," June 9, 1916, p. 328.

R. Gaillard has described an enlarger of the vertical type, designed to be a fixture, attached to the wall of a room. Two long uprights, each 3 inches in width and 1 inch in thickness, were nailed to the wall at a distance of 12 inches apart, centre from



centre. A pair of 12-inch shelf brackets were screwed to these uprights to form the support of the camera, condenser, and light-box. Details of the method of fitting the camera will be seen from Fig. 1.

The chief difficulty was a simple method of providing a vertically sliding shelf for the sensitive paper. The plan finally adopted was as follows:—Between the pair of uprights already mentioned another was placed about 4 inches wide, with its centre exactly beneath the camera lens, first placing in position a $\frac{3}{8}$ -inch bolt, so located as to allow an up-and-down motion of bromide board of about 1 ft., this distance giving from $1\frac{1}{2}$ to $2\frac{1}{2}$ diameters enlargement. Another pair of shelf brackets was necessary for the sliding shelf, the same being screwed on upright side to a board about
(Continued on next page.)

Fig. 1.

- A—Rabbeted cleats to hold negative glasses fastened under lower part of condensers.
- B-B—Condensers.
- C—Ordinary fluted glass light reflector.
- D—Light stop to extend into camera.
- E—Thin boards fastened to bottom of box to fit camera back; cleats under the same hold camera in place.
- F—100-watt nitro lamp.

12 inches wide and 16 inches long, this board having a slot $\frac{3}{8}$ -inch wide and 12 inches long down its centre, through which the bolt on stationary upright worked. A bromide board was screwed to the shelf brackets. A pair of wooden cleats was then fastened to the rear side of the sliding shelf, fitting snugly on each side of the stationary upright, these cleats preventing the shelf from getting off a horizontal, and keeping it exactly in the plane of the negative and lens. A thumb nut screwed up on the bolt then held the sliding shelf in whatever position desired.

In actual practice it was found that $2\frac{1}{4} \times 3\frac{1}{4}$ negatives will

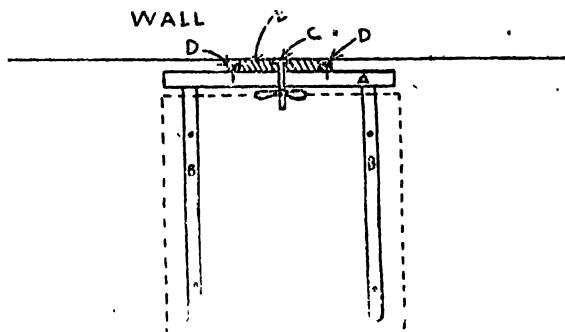


Fig. 2.

DETAILS OF SLIDING SHELF.

- A—Upright board with up and down slot in centre for bolt.
- B—Pair of shelf brackets fastened to A.
- C—Bolt so placed in upright E as to allow necessary up and down movement of A.
- D—Cleats nailed to A to make good sliding fit on E and keep bromide board horizontal.
- E—Upright from floor long enough for necessary movement of shelf. Dotted lines show bromide board in place.

hardly stand more than $2\frac{1}{2}$ times enlargement (diameters), and accordingly the shelf was kept at one position, and the lens the same all the time, so that to make an enlargement it was only necessary to place negative and bromide in position and make the exposure. That is the chief advantage of this vertical type of enlarger; it is always ready, and takes up practically no room.

Another advantage is that an ordinary printing frame makes an ideal bromide paper-holder when using stock sizes of paper, such as 5×7 or 8×10 . One can project the image on to the bromide board, place printing frame, with paper therein, in position, and focus, of course keeping the lens covered with safety glass. This method is especially useful when enlarging from a portion of negative only, as the printing frame can be moved around until the correct position is found, and the paper is not marred by thumb-tack holes, as in the usual method, and it is also easy to

use masks to produce white border round print. The printing frame also holds the paper perfectly flat.—“Amer. Phot.,” Dec. 1915; “B.J.,” Dec. 17, 1915, p. 812.

Calculating Exposure in Enlarging.—Anketell Henderson describes home-made measuring instruments for ascertaining the speed of bromide papers and for applying the figures thus obtained in finding the exposure when enlarging. According to a method already described (“B.J.A.,” 1916, p. 483), to ascertain the speed of the paper he gives a series of exposures graded in candle-foot seconds, and takes the shortest exposure that gives a visible result as a measure of the speed. This test is, of course, made only once for any particular supply of paper, and, when enlarging is started upon, all that remains to be done is to make a simple visual test with the lantern. By applying the principle of the Rumford single-rod photometer, and using a candle as a comparison source of light, he gets the value of the light projected on the darkest parts of the image in candle-feet: dividing the result into the speed of the paper then gives the required time of exposure in seconds.

In a later article he modifies the speed test by using a home-made sector wheel in place of a series of exposures.—“B.J.,” Jan. 7, 1916, p. 4.

Distorted Enlargements.—J. Peat Millar gives a simple method of obtaining linear distortion of a subject in making an enlargement. The enlarging easel is placed, not in the customary position facing the lens, but with its surface parallel with the axis of the lens and in a little way to one side or the other. Facing the lens is placed a mirror and the image is reflected from the mirror on to the enlarging easel. If the negative is placed upright in the enlarger a broadening-out effect of the face is obtained, but if lying on its side the face is lengthened out.—“A.P.,” Dec. 20, 1915, p. 494.

Two-step Enlarging Without a Lens.—A. J. Lotka has described a process which is something of a curiosity among enlarging methods. No lens is used, but the negative is caused to move past a slit and its image impressed upon a moving sensitive plate. The distorted positive transparency thus obtained in this first step is subjected to the same process, but in a direction at right angles to the first. The author gives the method of calculating the degree of enlargement which can be obtained in this way without loss of definition, and states that the process is protected by a United States patent No. 1,176,384, of March 21, 1916.—“B.J.” (from Journal of the American Physical Society), July 21, 1916, p. 407.

Working-Up Photographs.

Pastel-Colouring of Toned Prints.—Dr. D'Arcy Power has recently published full working details of the photo-pastel method of producing prints in colours worked out by himself. The basis

if the pastel work is a two-colour print prepared from a bromide by first carrying out local sulphide-toning in appropriate parts of the subject, and then further toning the whole print in a gold-sulphocyanide bath ("B.J.A.," 1911, p. 582). The process, of course, in its final stages, calls for skill and artistry in the use of the coloured pastels; but judging from reproductions and reports in the American Press, is capable of yielding extremely fine results.

The essentials for the production of a colour-print which is artistically and technically good are signalled by Dr. Power as follows :—

1. A negative in which the colour values are reasonably correct.
2. A bromide enlargement having a surface capable of holding pastel.
3. Converting all those parts of the image which are to appear in the final result as red, orange, or yellow into the sepia tone of the sulphide process.
4. Pigmenting the print with pastel; and
5. Fixing the pastel colouring.

As regards these various stages in the process, a suitable negative is obtained by using a Wratten panchromatic plate with a three-times screen

the outlines, of the bromide print are defective, they should be modified before proceeding to make the colour applications. At this stage the picture is in two colours. The next operation is to work up with pastel in order to obtain the full colour effect. The best pastels are those of French manufacture supplied in boxes containing sticks of the pure colour worked up with a little gum-water to various grades of dilution with white pigment. One of the best brands (Girault's) is supplied in eight tints. Weber's pastels are made in a number of tints and degrees of hardness.

For applying the pastels there are required some pads of blotting paper (on which to try colours) and clean stumps: paper stumps (tortillons), and a few leather, as well as three or four felt stumps. These suffice for the laying-on of the colours. The average tint of the foreground, the chief colour elements of the mid-distance and the tints of the sky should be applied with cotton-wool stumps made by twisting a piece of cotton-wool into a small pad, rubbing the selected pastel thereon, and then using an extremely light circular movement in applying it to the paper. At this stage the lightest tint should be used, and there is no need to be extremely accurate in limiting the various colour areas. These latter are defined when applying the stronger colours.

The parts of the picture next to be dealt with are the main large objects, such as buildings, tree-trunks, or draperies, which are put on with the paper stumps or, where special blending is required, with the leather stumps.

Where contrasting colours come close together it is generally better first to put in each shadow as an individual speck of pastel, dabbed on by means of a small piece of paper stump, and then, by means of a piece of cotton-wool (compressed until it gives a small hard surface), to bring about the union of shadow and light by short dabbing movements with no horizontal "excursions." After this has been done it will often be necessary to blend masses that may be heavy in tone and difficult to unite. For these the felt stump is most useful, as it picks up and holds the superfluous pigment.

For the fixation of the pastel the pigmented print is placed face downwards on a sheet of blotting-paper, taking care that the edges are held in close approximation. The back then thoroughly wetted with a sponge until the paper stretches. The blotting-paper prevents the wetting of the pigmented side. A piece of cardboard is, in the meanwhile, pasted with stiff paste, the pigmented bromide carefully placed thereon, covered with a sheet of thin celluloid, and carefully rubbed down. So long as the print is held steady none of the pigment will come off, and the moisture penetrating through the paper to its gelatinised surface will bring about the firm adhesion thereto of almost all the colour. In most cases this is enough. If, however, the image has received at any point a very large amount of pastel, or if active scrumbling has been done, it may be necessary to fix further by spraying the parts with a solution of celluloid in amyl-acetate.

This is best done by holding the print horizontally over an oil atomiser containing the solution at such a distance that the larger drops of fluid do not reach its surface.—“Cam. Craft,” Feb., 1916; p. 55; “B.J.,” Feb. 25, 1916, p. 111.

As a reliable fixative for pastel work, Miss M. Venables recommends that of “Ferragutti,” sold by Messrs. Roberson, of Long Acre, London, W.C. It is simply sprayed on immediately the work is done. The first effect appears to be total ruin, but when dry the tones are untouched. This fixative has been found to preserve unchanged pastel sketches made directly with the pastels, and far more difficult to fix than those done with stumps or wool.—“B.J.,” Mar. 3, 1916, p. 134.

A. V. Godbold recommends the following recipe for a pastel fixative, which does not blacken or cause running or make charcoal leave the paper. It does not lower the tone more than shellac, and has the advantage of being much cheaper; also, it hides the shine in pencil work:— $\frac{1}{4}$ oz. white wax (beeswax) is emulsified by a few grains of carbonate of potash in a water bath, and $\frac{1}{4}$ oz. of benzine and a few drops of ammonia then added. Stir and keep hot for a minute or so to let the ammonia pass off, then add a further $\frac{1}{2}$ oz. of benzine. Spray in the usual manner.

An alternative means of using this fixative on plain paper is to draw the subject in charcoal, spray well, colour in pastel, and then fix by steam.—“B.J.,” Mar. 10, 1916, p. 146.

French-Polishing Prints.—At a demonstration before the Croydon Camera Club, W. H. Smith, manager of the Platinotype Company's works, showed the effective results which could be obtained by french-polishing photographs made on papers having a hard, impermeable surface, such as Japine Platinotype and Silver Japine. Prints on other photographic papers might be amenable to the process. If they allowed oil to penetrate within half an hour they would be unsuitable; the Japine papers showed signs of oil coming through only after forty-eight hours. The effect of the french-polishing is to give an extremely brilliant polish, quite unlike the glaze of a squeegeed or varnished print. Among the hints given by Mr. Smith for successful working are the following:—A fine, not a muggy, day should, if possible, be selected, the temperature of the room being maintained between 70° and 75° F. If the room be too warm evaporation will be too quick, and the polish will dry in lines; if too cold, evaporation will be unduly retarded. In damp weather the polish works in a streaky fashion, and badly.

The materials required are few and inexpensive. Some raw linseed oil, french polish, cotton-wool, and pieces of nainsook or old calico are all that is necessary. The white polish should be used when purity of the whites is desired to be preserved. For an ivory tint, white and ordinary polish are used in succession, ordinary polish being applied alone for a buff hue suitable for sepia prints. The polish and oil had better be purchased from an ironmonger or oil-merchant having a large sale, which ensures

comparative freshness, for all oils and varnishes deteriorate if kept for a long time. A gallon of each will be sufficient for many pictures, for 60 to 100 minims of polish and a few drops of oil suffice for a 12 by 10 print. The print should be mounted on a card, with a margin of an inch or so, and as flat as possible for any undulations or waviness are accentuated. If already mounted on a card of same size, it is a good plan to stick the print on a larger card with a dab of sealing-wax, which allows easy separation; there should be nothing in the way to check movement of the hands—that is essential.

The "rubber" or pad is in the form of a firm "dolly," cotton-wool forming the inside, the nainsook or calico, stretched tightly over, being the polishing surface; pieces of a well-worn shirt are excellent. If a square be cut, each corner can be utilised in turn, thus economising discarded under-garments. For small pictures flannel is to be preferred to the cotton-wool. The dolly-pad (about twice the linear dimensions of a respectable walnut) is held tightly, and a small quantity of oil applied with the finger-tip, which is distributed up and down the print until only a trace of oil remains on the surface. A little polish is next placed on the pad and allowed to penetrate, its correct condition being soon learnt by lightly dabbing it against the back of the hand. A "body" is then given the print by applying the pad longways and crossways. If this be continued it will result in the pad sticking, so a drop of oil is added, and the print again gone over, but now with a rotary motion, first with large circles, then in smaller, always starting at the edges and working inwards, the polishing being continued so long as the surface seems slippery. When the pad begins to drag—beware of that drag—add a little more oil. The preliminary oiling should be effected with a separate wad or rag, followed by polish *only* on a fresh wad. In all cases the oil should be applied to the rag forming the outer covering; the polish, to the cotton wool mixture. One application of the polish will afford a fair gloss, but to obtain the full beauty about three coatings are requisite.

Three applications are usually necessary, sometimes more. Gradually the surface will become of a more uniform glaze, until final triumph is assured, provided, of course, all has gone as it should. Always remember the less oil used the better, the idea being to make the oil last the polish out, or the polish last the oil out, either course answering equally well. A decidedly firm pressure is requisite, but never apply the pad with the downward dab beloved by the oil artist, or a dull patch will follow. The correct method is to "slither" it on, keeping the pad in orbital paths.

It will be noticed, when the polish is getting dry on the pad, that bright and dull patches will be seen on the print, the bright patches which look wet are dry, and *vice versa*. A candle placed away from the perspiring operator affords artistic "front lighting," and at the same time shows up the bright and dull parts. As the polishing proceeds, some of the glaze may be due to an excess of oil. To test if this be so, pass the back of the hand over

the print; if present in excess it will streak, and, in addition, the circular rubbing marks will disappear. If it smears without obliterating the marks things are right. If the marks vanish, showing too much oil, a fresh portion of the outside rag must be stretched over the wool, and polish alone applied. Sometimes fresh wool may be necessary; but be sure it is an excess of oil which is giving the smears. If at any time the polish be in excess, resulting in an early "drag," a trace of oil is applied.—"B.J.," Dec. 31, 1915, p. 85i.

Mr. Smith also showed a further refinement in the operation:—A few teaspoonfuls of pumice powder are held in two thicknesses of butter-muslin in "dolly" fashion, and the print is lightly gone over. A final application of the polish will result in the maximum brilliancy and smoothness it is possible to obtain. For a 12 by 10 print, he had ascertained about 6 drops of oil, and from 60 to 120 minims of polish, according to the "body" desired, are sufficient. He also said much time would be saved by treating several prints together.—"B.J.," Jan. 7, 1916, p. 11.

Mr. Smith has also given the preparation "Polvar" a trial for french-polishing "Japine" prints, and finds it excellent for the purpose. No difficulty should be felt by the inexperienced if the plain directions on the jar are followed. It sets somewhat rapidly and works rather thinly, about eight coats being required to obtain a really good body and fine surface on the print. Compared with ordinary polish, it is more expensive, and takes about the same time to secure the same finish. "Polvar" is supplied by its agent, Mr. Geo. Pearce, 133, Fenchurch Street, E.C., the smallest size jar of "white polish" being 1s. 2d. (postage 5d.). Apart from polishing prints, many will find it a useful preparation for french-polishing wood, renovating furniture, studio accessories, etc. Various coloured polishes can be obtained. If the white polish be used for renovating articles french-polished with a coloured polish, only a light application should be made, or the original coatings may be affected.—"B.J.," Feb. 4, 1916, p. 73.

Lantern Slides.

Control in Lantern-slide Making.—T. H. Greenall has worked out and recommends a system for the development of lantern slides by which good results may be obtained from negatives of different character, some thin and delicate, others dense, others flat in gradation, and others more or less great in contrast. The system is for use with chloro-bromide plates (slow lantern plates). Development is commenced in a weak, highly-restrained developer, in which the deepest shadows begin to appear and gradually attain density.

The exposure having been judged as nearly as possible according to the result desired, a start is made in a dilute, highly-restrained developer, which commences with the deepest shadows and gradually piles up density. After this has continued for some time the slide is taken out and finished (when the exposure given has been short

of that necessary for the restrained developer) in a second or detail-giving reagent. By this method it is easy, with chloro-bromide plates, to get equally good results from a given negative with exposures varying as one to three, and without knowing beforehand what the exposure has been. The colour of the slides will vary with the exposure, but all the colours are pleasing.

The development should be done in ample light, say one or two thicknesses of yellow paper, with an incandescent gas mantle in the darkroom lamp. The illumination should be such that small type can be easily read at 3 ft. from the lamp.

As hydroquinone is a constituent of the first developer, care requires to be taken that the temperature of the darkroom does not fall much below 65 deg. F. If this cannot be done, a night-light may be placed on the dark-room table, screened with a box about 6 ins. in depth to keep in the light, a big porcelain dish containing about one quart of water laid on the box, and in this dish the small developing tray or tank.

For Paget slow lantern plates the following is a good formula for the first developer :—

Hydroquinone	6 grs.
Pyrocatechin	6 grs.
Citric acid	6 grs.
Potassium bromide	6 grs.
Potassium metabisulphite	9 grs.
Sodium sulphite	60 grs.
Potassium carbonate	80 grs.
Water	to make 24 ozs.

The ingredients may be kept separately in more concentrated solutions, the metabisulphite being used to preserve the two developers; but it is important that the total amount of metabisulphite in the mixed developer should be exactly as stated in the formula, otherwise the behaviour of the developer will be altered, unless an adjustment was made in the amount of alkali.

In this developer the image should appear, at first very faintly, in from eight to ten minutes; though, naturally, the image appears more quickly with fresh solution than as the solution becomes used. Development should be complete—i.e., density should be sufficient—in from twenty to thirty-five minutes, according to the character of the original negative and the result desired. From two to three dozen slides may be developed in the quantity of developer given in the formula.

The above is the restrained or density-giving developer. The second or rapid detail-giving reagent, only to be used after the restrained developer, and then only so far as may be necessary to bring up detail not developed in the restrained developer, or, in special cases, to soften gradation by shortening development, is composed as follows :—

Eikonogen	10 grs.
Sodium sulphite	60 grs.
Boiling water	to make 2 ozs.

In small, well-filled bottles this will keep many months. It may be used repeatedly, provided the slides are rinsed as they are transferred from the restrained developer. The time required in the eikonogen, of the strength as given above, varies from a few seconds upwards, whilst slides which have received ample exposure for the restrained developer do not, in the ordinary way, require treatment with the eikonogen at all.

The restrained developer, as given above, is intended to be used in a tank; but if it is made up with 6 ozs. instead of 24 ozs. of water the time for development is reduced to five or ten minutes, and it may be used in a dish. Dish development is, however, laborious.

As plates are exposed, they are put in the tank in rotation, at intervals of two or three minutes, to allow time for individual treatment. The time each plate goes in the tank is noted on a memorandum sheet, and at intervals of eight or ten minutes each plate is lifted for examination and returned to the tank. It is important in putting it back to put the other edge uppermost to equalise development. One precaution necessary in all tank development is that the upper edge of the plate must always be well below the surface of the developer.

Having gained density in the tank, slides which are short of gradation in the high-lights are transferred to the eikonogen. They must be rinsed before transferring. The effect of the eikonogen must be closely watched, whilst the dish is continuously rocked, and as soon as the highest lights appear distinctly veiled, as compared with the unexposed margins of the plate, development is complete. When the eikonogen is used prematurely with the object of softening the gradation, its action is naturally very rapid—a few seconds will suffice—the slide being then immediately plunged into an acid fixing bath. On the other hand, with short exposures, insufficient for the restrained developer, which have already been in the tank for the normal time, the action of the eikonogen is comparatively slow and regular. Should the lights refuse to develop in the eikonogen, the negative is too hard for slide-making, or the exposure has been much too short, or the eikonogen, through excessive use, has become exhausted or contaminated with restrainer. It must be clearly understood that with full exposures the eikonogen has a very powerful softening effect on the gradation, and must therefore be used cautiously; whilst with short exposures its effect is normal. If, after fixing and washing, the slide looks rather thin or lacks "body," it may be greatly improved by strengthening it with the chromium intensifier.—"Phot.," Feb. 15, 1916, p. 118.

Masking Slides with Paper Strips.—W. E. Cochrane recommends the use of a guide board in laying the masking strips upon the slide so that they leave a space which is perfectly square and rectangular. A convenient size of board is 7 by 9½ ins. by ½ inch. On it is glued a piece of card with an opening in the centre which just takes a lantern plate. The two strips are of wood, and are screwed down so that their inner edges are exactly parallel with the edges of the sides and ends of the slide respectively. The

use of it is obvious. The slide being placed in the opening for it, a celluloid square is laid on top, one of the two edges forming its right angle is brought up against one of the strips, and it is then slid up and down until it is in the required position, when it is held firmly with one hand, while the mask is laid down against it with the other. Or a pencil line may be ruled on the film and the mask laid against that, if the photographer feels it necessary to have both his hands free for the masking.—"Phot.," Jan. 18, 1916, p. 47.

Cinematography.

(Space will not permit of reference to the numerous patents for cinematograph cameras, projectors, and films for animated photography in monochrome and natural colours. The specifications are published or abstracted in "The British Journal of Photography," and entered in the annual index of that publication under (1) Cinematographs and (2) Name of Patentee.)

VI.—COLOUR PHOTOGRAPHY.

Patents for Colour Photography.—The chronology of the patent specifications relating to colour photography commenced in the monthly "Colour Photography" Supplement to the "British Journal of Photography," Jan. 4, 1907, is concluded with the issue of Dec. 6, 1907, p. 96. All current patents are dealt with week by week in the "British Journal of Photography," and are entered in the annual index under (1) Colour photography, and (2) Name of patentee.

Two-Colour Processes.

Kodachrome Portrait Colour Transparencies.—The patent specification of J. G. Capstaff contains a formula for the bleaching-bath, serving for the conversion of an ordinary negative into a dye positive-transparency, as mentioned in the outline of the Kodachrome process in "B.J.A.," 1916, p. 490. The bleaching-bath is as follows :—

A.—Potassium ferricyanide	37.5 gms.
Potassium bromide	56.25 gms.
Potassium bichromate	37.5 gms.
Acetic (or similar) acid	10 c.c.s.
Water	1,000 c.c.s.

B.—Potassium alum 5 p.c. solution

For use take equal parts of A and B. The solution may be diluted by adding water.

After bleaching and before dyeing it is preferable that the gelatine coating on the plates be dried thoroughly, otherwise the dye is liable to attach itself to parts which ought to remain clear. An acid dye (preferably a salt of sulphonic acid) is used in compounding the dye-bath, and, after dyeing, the films are rinsed again in water, dried quickly, but preferably treated with dilute acid, which has the effect of "fixing" the dye. The acid treatment is particularly advisable where the process is being used in producing colour film of great length.—Eng. Pat. No. 13,429, 1915, "B.J.," Aug. 4, 1916, p. 434, and "Colour Photography" Supplement, Aug. 4, 1916, p. 30. J. G. Capstaff, in a further patent specification, describes a system and optical instruments for the production of cinematograph two-colour films by the Kodachrome process. Duplicate negatives are taken, through appropriate light-filters, upon a single-coated colour-

sensitive film. From this colour-sensation negative a positive is printed by contact, and this positive film is then optically projected upon opposite sides of a sensitive double-coated positive film, the opposing negative impressions thus produced being then converted into dye-positives by the Kodachrome process. The drawings of the optical printing instrument are reproduced from the patent specification (No. 13,430, 1915) in B.J. "Colour Photography" Supplement, Sept. 1, 1916, p. 34.

Two-colour Camera.—According to the "Scientific American," a camera designed by P. D. Brewster, of New York, is being successfully used for simultaneous two-colour exposures with a single lens. The feature of the camera, for which novelty is claimed, is the mirror, by which the pencils of rays from the lens are partly transmitted to a plate at the rear of the camera immediately facing the lens and partly reflected to the second plate disposed horizontally in the top of the camera. For this purpose the mirror, which is of nickel or silver, is perforated by a number of holes made at an angle of 45 deg. to the surface of the mirror. A green filter is placed in front of the plate which receives rays through the mirror, whilst a red filter is placed below the horizontal plate which receives the reflected rays. It is stated that studio exposures are made in from two to eight seconds, and outdoor exposures in sunlight in as short a time as 1-50th of a second.—B.J. "Colour Photography" Supplement, June 2, 1916, p. 21.

Drawings from the British patent specification (No. 100,082) of the camera are reproduced in "B.J.," Sept. 29, 1916, p. 536.

Three-Colour Processes.

Trisected Lens for Colour Camera.—D. S. Plumb has patented a lens for the making simultaneously of the three colour-sensation negatives. The lens is composed of elements made by cutting, edge-grinding, and transposing a lens of the ordinary type, thus making it possible to arrange the diaphragms very close together, and so to avoid differences in the negatives due to separation.

The lens is made up of elements, *a*, which are, in ordinary lenses, of the circular shape shown in Fig. 1. The edges of these elements, *a*, are first ground to the hexagonal form shown in Fig. 2, and then cut into segments, *b*, *c*, *d*, as indicated in Fig. 3. The arrows shown in Figs. 1 to 4 indicate the position of the lens material in these views. It will be noted that the segments, *b*, *c*, and *d* (Fig 3), are of a regular diamond shape, their inner cut edges being identical as regards length and angle with their outer ground edges. These segments, *b*, *c*, and *d*, are reversed, bringing their outer ground edges together, and cemented, recomposing the lens in hexagonal form, with the edge portions of the original element, *a*, at the centre of the recomposed lens element, and the central portions of the original element, *a*, at three equi-distant points on the edge of the recomposed lens element. In grinding the hexagonal shape upon the edge of the original lens element, *a*, care is taken

to keep the straight ground edges parallel to the axis of the lens, so that when the segments are reversed and cemented, the three separated axes of the recomposed lens element will be parallel. The lens is now assembled, preferably in a hexagonal tube, *f*, with

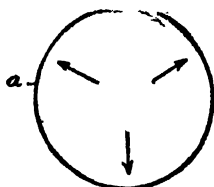


Fig. 1.

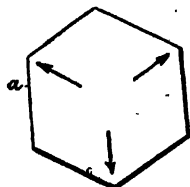


Fig. 2.

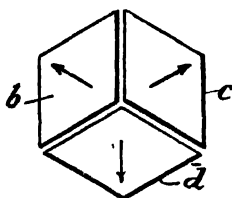


Fig. 3.

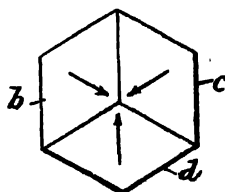


Fig. 4.

the usual spacing pieces and three leafed partitions interposed between the spaced elements to avoid the crossing of light.—Eng. Pat. No. 8,447, 1915, "B.J.," Nov. 12, 1915, p. 739.

Finding Exposure Ratios in Three-colour Work.—S. M. Furnald and A. J. Newton, in a communication from the Eastman Research Laboratory, have described an instrument for determining simply and rapidly the relative exposures to be given through the three light-filters when using a given plate and when working by any given illumination.

If the reproduction camera is fitted with a transparency attachment, this latter is best used for the trials necessary for ascertaining the correct ratios. A transparency is mounted on a long strip of black card, which is caused to slide in grooves fastened to another card, so that its image can be placed to come into a series of positions on a plate placed in the holder of the camera. Adopting this arrangement, a first exposure is made without a filter and with the transparency at one end of its frame. The transparency is then pushed along, and a second exposure made through the blue filter, employing a ratio which is assumed to be correct. It is then again pushed along through successive distances, and exposures made through the green, red, and yellow filters respectively. The distance through which the transparency has to be moved is conveniently indicated by a mark on the card on which it is mounted. On

development of the plate it will be seen whether the exposure ratios have been correct. If some of the exposures are seen to be too long or too short, new ratios require to be adopted and confirmed by a further trial.

In the absence of a transparency attachment the same process can be carried out by means of reflected light. In this case a cardboard box is made, and lined with black velvet. Convenient dimensions are:—13 ins. long, 6 ins. high, and 3 ins. deep. On the front of this box two slides are arranged so that a neutral black and white print, mounted on a piece of card, can slide along. This is fastened to the copyboard, and a series of successive exposures made as before, but moving the print instead of the transparency. Beneath the print is placed a strip of graded densities, each patch requiring twice the exposure of the previous one, in order to yield the same density on the plate. Thus by this means, if the negative obtained through one filter differs from the others, an examination of the graded strips will at once show what alteration of the ratio is necessary, it being borne in mind that a shift of one step is equivalent to a doubling of the exposure.

On the frame underneath the movable print the names of the filters are marked in black ink on grey paper, the grey paper being used to avoid over-exposures of the titles, which are, of course, exposed each time that a negative is made.

In order to make quite sure that the correct filters have been used, the three colour inks are also pasted on the original. Thus, in the blue-filter negative only the blue patch will come out dense, and the other two patches will be more transparent. In the green-filter negative the pink patch will remain transparent, while the blue and yellow patches will have more or less density. In the red-filter negative the red and yellow patches will be dense, while the blue will be transparent. In the K3-filter negative the patches will appear of the same relative intensity that they present to the eye, and in the exposure made without any filter the blue patch will be dense and the other two patches more transparent.—B.J. "Colour Photography" Supplement, March 3, 1916, p. 9.

Three-Colour Prints.

Three-Colour Prints.—J. Lewisohn has patented a method (of producing prints possessing multicolour effects) consisting in coating with a blue-print sensitiser an image of different colour, which was originally a blue-print, and then forming a blue-print image. A set of colour-sensation negatives having been made in the usual way, prints therefrom are made, but first a blue-print from the yellow printer negative. The entire blue image of this blue print is given a yellow wash such as aurantia, is then dried and then placed in a bath of silver nitrate strong enough to dissolve out the blue and leave the yellow. The silver nitrate is washed out and the print dried. The image side of the print is then coated with blue-print sensitiser and the print then exposed under the "red-colour component negative" in register. The blue-print thus formed is given a wash of red colour such as red eosin, dried,

and treated with silver nitrate as before, leaving the red and yellow images. The image side is again sensitised with blue-print sensitiser, dried and exposed through the blue-printed negative, and in register therewith. It is then "developed" and yields a print substantially in natural colours.—Eng. Pat. No. 2,474, 1915. "B.J.," Oct. 6, 1916, p. 548.

Three-Colour Prints by Bromoil Transfer.—Charles Donaldson gives working details of preparing three-colour prints from sets of colour-sensation negatives by the Bromoil transfer method. The bromide prints from which the Bromoil (to be pigmented) is to be prepared must be vigorous and full of detail, preferably developed in a well-restrained but weak amidol developer for at least five minutes.

In transferring from the pigmented Bromoils to the final support the yellow is first applied and then thin impressions of the red and blue alternately until the image is built up with the full range of tones and depth of colour desired. Each printing must be thoroughly dry before the next is applied.

The chief difficulty is in obtaining satisfactory register. The following is the method found satisfactory:—

Before bleaching the prints—that is, after they have been fixed in plain hypo—the acid fixer comes after the bleaching—take the print for the blue and one of the others—it is immaterial which comes first, as all three must be dealt with—and lay them dripping wet on a sheet of glass, keeping the blue print on top. The water between the prints causes them to slip backwards and forwards easily, and, held up to the light, the prints can be quickly brought into register. Then firmly hold the prints together, allow the water to drain away for a few moments, and then the prints, since they cling together, will not go out of register if carefully handled. Taking them off the glass, lay them on a smooth table. Next pierce a hole through the prints anywhere near each corner. A darning needle is just the thing. The third print is treated in the same manner, brought into register with the blue printer, and holes pierced near the corners to correspond with the others. Three holes can suffice, but it is best to make four. After the yellow print has been inked and put into position on the paper to receive the transfer, guide marks are made with a soft lead pencil by drawing a line from the pierced holes to the edge of the paper. These can easily be removed, when printing is completed, and thus leave a clean margin all round the finished print. In all subsequent printings it is only necessary to bring the holes in line with the pencil marks to ensure correct register.

The process can be applied to a variety of final supports, including paper ranging from smooth (even glossy) to the roughest handmade, canvas, or painted wood.—B.J. "Colour Photography" Supplement, July 7, 1916, p. 25.

Further suggestions and hints in regard to this process are given by C. H. Hewitt in "Colour Photography" Supplement, August 4, p. 29, and by Mr. Donaldson in "Colour Photography" Supplement, September 1, p. 33.

One-Plate Three-colour Processes.

PROCESSES OF PREPARING SCREEN-PLATES.

Lenticular Colour Screen-Plates.—A. Keller-Dorian has patented a method of manufacturing films according to which the surface of the film is covered with transparent refracting lines or points, forming an infinite number of objectives and serving in conjunction with light-filters for the production of colour transparencies. Eng Pat. No. 24,698, 1914.—“B.J.,” February 25, 1916, p. 117.

SCREEN-PLATES ON THE MARKET.

Under this heading are described processes which at the time of writing (Sept., 1916) are not on the market.—ED. “B.J.A.”

THE LUMIERE AUTOCHROME.

Black and White Prints from Autochromes.—A German worker recommends the following light-filter for use in the production of a monochrome negative by contact printing from an Autochrome:—Two ordinary dry-plates are fully fixed and washed and immersed whilst still wet, one in each of the following baths for four minutes:—

I.

Höchst's filter green	0.5 gm.	8 grs.
Water	100 c.c.s.	3½ ozs.

II.

Höchst's filter yellow	1 gm.	15 grs.
Water	100 c.c.s.	3½ ozs.

The plates are then rinsed for a minute in water and dried. The two plates (one green and one yellow) are now laid together face to face and the edges bound with gummed paper. This filter is placed in the printing-frame, and upon it the Autochrome without its protecting glass; then an orthochromatic non-halation plate is laid on and the exposure is made.

For the purpose of preventing false light from reaching the plate, it should be covered in the frame with a piece of black cloth or paper. Of course, the yellow-green filter may be placed outside the frame in case the springs do not allow room for four thicknesses of plate.—“Photo Era” (from “Phot. Rund”), Nov., 1915, p. 237; B.J. “Colour Photography” Supplement, Aug. 4, 1916, p. 32.

Reproducing Colour-Screen Transparencies.—E. A. Biermann has described the method of illumination found best in reproducing such screen transparencies as Autochromes satisfactorily, yet without risk of injuring the delicate film. The most successful results were obtained with a wooden box without ends, lined first with asbestos and then with thin litho-aluminium ungrained, which

keeps its colour well. At one end are formed four grooves one inch apart, wide enough to take sheets of ground glass, and it is as well to make the grooves wide enough to take two thicknesses of glass. In front of these is a tank which can be conveniently made of a

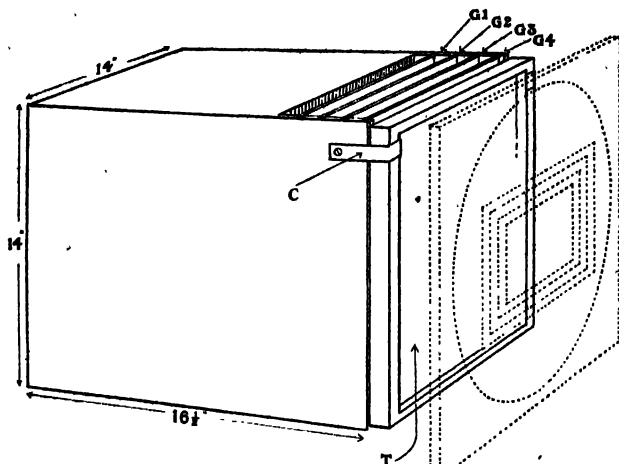


FIG. 1

metal framework with glass sides cemented in, allowing a measurement of one inch between the glass sides.

This tank is filled either with clean water or with coloured solu-

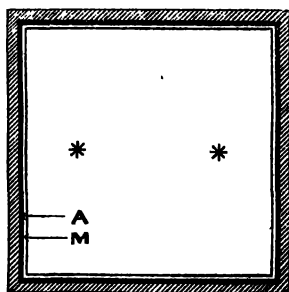


FIG. 2

tions, which are very convenient for correcting colour transparencies which are faulty in colouring for any reason. For example, with floral objects taken in flower shows, tints are always too yellow; to correct this defect the tank may be filled with a weak solution of

blue dye. The transparency is placed in front of this arrangement in a carrier, which may be of the revolving type, and should be movable so that the distance can be varied between the tank and the colour-plate, two to three inches being the average distance.

For illumination two projection arc lamps of 15 amperes each are used, but no doubt other types of lamps could be equally well used. The position of the arcs should be as near to the sides and ends of the box as is safe without causing over-heating. The light is reflected from the metallic lining from all four sides, and at every possible angle backwards and forwards until the whole interior is a mass of brilliant light of excellent copying quality. The amount of diffusion or damping of the light is regulated by the ground glasses, two or three being used for dense transparencies, and four or more for thin ones. The whole is erected in front of and in line with the camera, and the space between the lens and the transparency covered with an opaque cloth, when the colour-selection negatives can be made in the usual way, either with or without the half-tone screen.

In Fig. 1, G1 to G4 are diffusing screens; T is the glass tank, and C the movable metal clip for holding the tank. In Fig. 2, A is asbestos; M, metal lining, whilst the positions of the arc lamps are indicated by *.—"Process Year Book," 1916, p. 89.—B.J. "Colour Photography" Supplement, Jan. 7, p. 3, and Feb. 4, p. 7, 1916.

KEY TO THE ABBREVIATIONS OF JOURNALS QUOTED IN "EPITOME OF PROGRESS," WITH ADDRESSES.

[We publish this list of journals, as in previous years, for the reason that it is practically a complete directory of the photographic journals throughout the world. But it should be mentioned that during the past two years no French, German, or Austrian photographic publications have reached us with the exception of the "Photo-Revue," which is now published monthly. Ed. "B.J.A."]

"A. P."	.. ..	"The Amateur Photographer and Photographic News."
		Hazell, Watson & Viney, Ltd., 52, Long Acre London, W.C.
"Amer. Phot."	.. ..	"American Photography."
		221, Columbus Avenue, Boston, Mass., U.S.A.
"Apollo"	.. ..	"Apollo."
		Albrechtstrasse 39b, Dresden A 10, Germany.
"Atelier"	.. ..	"Das Atelier."
		W. Knapp, Halle a/Saale, Germany.
"Aust. Phot. Journ."	.. ..	"Harringtons' Photographic Journal."
		Harringtons', Ltd., 380, George Street, Sydney, Australia.

- "Aust. Phot. Rev." .. "Australasian Photo-Review."
Kodak (Australasia), Ltd., 379, George Street,
Sydney, Australia.
- "B. J." "The British Journal of Photography."
Henry Greenwood & Co., Ltd., 24, Wellington
Street, Strand, London, W.C.
- "B.J.A." "The British Journal Photographic Al-
manac."
Henry Greenwood & Co., Ltd., 24, Wellington
Street, Strand, London, W.C.
- "Bild" "Das Bild."
Neue Photographische Gesellschaft, 27, Sie-
mensstrasse, Berlin-Steglitz.
- "Bull. Belge" "Bulletin de l'Association Belge de Photo-
graphie."
Ch. Puttemans, Palais du Midi, Brussels.
- "Bull. Soc. Fr. Phot." "Bulletin de la Société Française de Photo-
graphie."
Gauthier-Villars, Quai des Grands-Augustins,
55, Paris, France.
- "Bull. Phot." "Bulletin of Photography."
210-212, North 13th Street, Philadelphia, U.S.A.
- "Cam." "The Camera."
210-212, North 13th Street, Philadelphia, U.S.A.
- "Cam. Craft" "Camera Craft."
413/415, Call Building, San Francisco, Cal.,
U.S.A.; and 3, Wine Office Court, Fleet
Street, London, England.
- "Cam. Work" "Camera Work."
Alfred Stieglitz, 1111, Madison Avenue, New
York, U.S.A.
- "Chem. News" "The Chemical News."
E. J. Davey, 16, Newcastle Street, Farringdon
Street, London, E.C.
- "Chem. Zeit." "Chemiker Zeitung."
Dr. G. Krause, Cöthen (Anhalt), Germany.
- "D. Phot. Zeit." "Deutsche Photographen-Zeitung."
K. Schwier, Sophien Strasse 4, Weimar, Ger-
many.
- "Der Amateur" "Der Amateur."
Mondscheingasse 6, Vienna VII, Austria.
- "Der Phot." "Der Photograph."
L. Fernbach, Bunslau.
- "Eder's Jahrbuch" "Jahrbuch für Photographie und Repro-
duktionstechnik."
W. Knapp, Halle a/S., Germany.
- "Il Prog. Foto." "Il Progresso Fotografico."
R. Namias, 36, Via Settembrini, Milan, Italy.
- "Journ. Phot. Soc. Ind." "Journal of the Photographic Society of
India."
40, Chowringhee, Calcutta, India.
- "Journ. Roy. Micr. Soc." "Journal of the Royal Microscopical
Society."
Williams & Norgate, 14, Henrietta Street,
London, W.C.

FORMULÆ FOR THE PRINCIPAL PHOTOGRAPHIC PROCESSES.

ORTHOCHROMATIC PROCESSES.

(Most of the formulæ in this section are those used in the three-colour and process department of the L.C.O. School of Photo-Engraving, Bolt Court, London, E.C., to the Principal of which, Mr. A. J. Bull, we are indebted for assistance in arranging them in the present form.—ED. B. J. A.)

Sensitisers for Gelatine Plates.

1.—For blue-green and green.

To sensitise up to wave-lengths, 5,500 A.U., a dye formerly found good was *acridine orange*, N.O. It was used as directed below for green and yellow sensitising, except that ammonia must not be used.

2.—For green and yellow, but not red.

To sensitise up to 5,900 A.U., *erythrosine* was formerly the best dye though it left the plates somewhat insensitive to bluish green.

One part of dye was dissolved in 1,000 parts of alcohol, and a bathing solution made as follows:—

Stock solution 1: 1,000	.. .. .	100 parts
Water	.. .. .	400 parts
Ammonia (0.880)	.. .. .	5 parts

This is 1: 5,000 solution.

N.B.—Ammonia must not be used with *acridine orange*.

3.—*Green, yellow and red.*

To sensitise for all rays up to 6,200 to 6,400 A.U. the following were formerly used:—

Orthochrome T, Pinaverdol, Pinachrome, or Homocot,

their order as red-sensitisers being as above.

A stock solution is made containing 1 part of the dye in 1,000 parts alcohol. The bathing solution contains:—

Stock solution	2 parts
Water	100 parts

This is a 1 : 50,000 solution.

The stock solution will keep, but the weaker bath will not. A red light is used, until it is seen that the solution has covered the plates, after which the operation must be continued in total darkness.

4.—*Extreme visible red.*

In sensitising for the extreme visible red, *pinacyanol* was formerly used. The operations can be done in a weak green light, passing the part of the spectrum between 5,000 and 5,300. The dye solutions are prepared exactly as those of *Orthochrome T*, etc. See above.

5.—*Panchromatic Plates.*

Hitherto the best results were obtained with a 1-50,000 solution of a mixture of pinachrome and pinacyanol, viz., 3 parts pinachrome stock solution, 2 parts pinacyanol stock solution; water, 250 parts.

6.—*Infra red.*

The best sensitiser for the infra red formerly in use was *dicyanine*, which is prepared and used exactly as pinacyanol, except that the stock solution must not be added to the water until the very last moment, when everything is quite ready, and the plate can be immediately flowed with the solution, as the weak solution loses its sensitising power very quickly.

If ammonia is used with the cyanine sensitisers given in 3, 4, and 5, it must be quite pure, or fog will be produced. It is best to dispense with it, but if used the proportion is about 1 part per 100 of sensitising bath.

PRACTICAL NOTES ON BATHING.

The dye solution is prepared in a measure, the plates are dusted and laid in a flat porcelain dish, which is large enough to hold nearly twice the number of plates it is desired to sensitise at one time. These are put at one end of the dish; the dish is then tilted, and the dye solution poured into the other (empty) end, then the dish is tilted back, so that the dye solution sweeps over the plates in one even flow free from air bells. The dish is now gently rocked for three minutes, then the plates are removed and washed in a good stream of running water for at least another three minutes. Their sensitiveness and keeping quality will probably be somewhat greater if they are washed for ten minutes, but they will remain good for months, kept under proper conditions, after three minutes' thorough washing, if bathed according to the formulæ given above.

The water tap should be fitted with one of the small anti-splash filters, the fine wire gauze in which retains any solid particles that may be in the water.

After washing, the plate should be well swabbed with a wad of cotton wool, and then placed in a drying cupboard. The quicker drying takes place the better, so that if a current of warmed, filtered air, free from fumes, can be sent through the cupboard it is an advantage, though the absence of this convenience need not deter anyone from sensitising plates. Drying can be hastened by placing a dish of dry calcium chloride or quicklime at the top of the cupboard.

Sensitisers for Collodion Emulsion.

The three following sensitising dye-baths were formerly recommended by von Hübl.

FOR GREEN AND GREENISH YELLOW.

Pinaverdol (1 : 500)	..	..	1 oz.	40 c.c.s.
Collodion emulsion	..	..	25 ozs.	1,000 c.c.s.

The sensitiveness extends from the orange to the violet.

PANCHROMATIC SENSITISERS.

Pinaverdol (1 : 500)	..	..	3 ozs.	30 c.c.s.
Ethyl violet (1 : 500)	..	..	$\frac{1}{2}$ oz.	5 c.c.s.
Collodion emulsion	..	..	100 ozs.	1,000 c.c.s.

Pinacyanol can be substituted for ethyl violet.

FOR RED SENSITISING.

Pinacyanol (1 : 1,000)	..	..	3 ozs.	3 c.c.s.
Collodion emulsion	..	..	100 ozs.	100 c.c.s.

FOR BLUE AND (SLIGHTLY) BLUE-GREEN SENSITIVENESS.

The following sensitiser increases the sensitiveness of the collodion ordinary work :—

Canary II. (sat. sol.) (Reade Holliday, Huddersfield)	..	..	1 oz.	10 c.c.s.
Emulsion	..	..	10 ozs.	100 c.c.s.

The dyed emulsion keeps well, and in half-tone work gives a sharp clean dot, but its speed is not improved.

Safe-lights for Developing.

The dyes hitherto in most general use for the preparation of safe-lights and the quantities of each for a unit area are as follows :—

(Newton & Bull.)

Yellow safe light for wet plates, bromide papers.

	Per sq. om.	Grs. per sq. in. (approx.)
Tartrazine	1 mgm.	$\frac{1}{16}$
Or brilliant yellow	0.5 mgm.	$\frac{1}{32}$
Or naphthol yellow	1 mgm.	$\frac{1}{16}$
Or auramine	2 mgm.	$\frac{1}{8}$

Red safe light for ordinary plates.

	Per sq. cm.	Grs. per sq. in. (approx.)
Tartrazine	1 mgm.	$\frac{1}{10}$
Rose bengal (or fast red) ..	0.5 mgm.	$\frac{1}{20}$

Safe light for Ortho plates.

The above screen is combined with one containing—

Methyl violet	0.5 mgm.	$\frac{1}{20}$
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The red screen transmits light from the end of the visible red about λ 7,000 to λ 5,900 in the yellow. The methyl violet absorbs from λ 6,500 to λ 5,000, so that the only light passing the two is the extreme red of λ 7,000 to λ 6,500.

The dyes are dissolved in gelatine solution, which in winter should be about 8 per cent. in strength and about 10 per cent. in summer. About 20 c.c.s. should be allowed for every 100 sq. cm. of glass, i.e., about 20 minims per sq. in. The dyes are added, most conveniently from stock solutions, in quantity to give the proportions stated above in the filters.

DEVELOPERS AND DEVELOPMENT.

In this section we give developers for plates, roll and cut films arranged in alphabetical order.

PROPERTIES OF CHEMICALS IN COMMON USE.

Soda sulphite should be in clear crystals. It should be kept well corked, otherwise the crystals become dull and powdery. Such sulphite must be rinsed for a few seconds, in a measure, with enough cold water to cover it, the water poured away and the crystals dried on a clean cloth and weighed out. Warm water, not hot or cold, is the best to use. The ordinary form of sulphite (to be used in all formulæ in this book unless otherwise directed) is the "cryst." The "anhydrous" is a stronger variety, 1 part of which is equivalent to about 2 parts of "cryst."

Potass. metabisulphite should be in flattish crystals, with only a little powdery coating on them. Both dry and in solution it keeps much better than sulphite, and goes much further as a preservative. It should be well corked.

It must not be dissolved in hot water. Metabisulphite is an acid substance, every grain neutralising 1 grain of soda carbonate cryst., $\frac{1}{2}$ grain of caustic potash, $\frac{1}{2}$ grain caustic soda, or $\frac{1}{10}$ grain dry potass. carbonate.

Soda carbonate, cryst., is best purchased from a photographic dealer; washing soda ("sal soda" in the U.S.) is a more or less impure form. The salt loses water in the air, becoming thereby somewhat stronger, and should therefore be kept well corked.

Potass. carbonate should be purchased "dry" and be most securely corked; it absorbs moisture greedily, and if it has been kept for any time should be dried in the oven before weighing out.

Caustic potash.—Purchase as "best stick pure" and keep well corked. Weigh out quickly and handle as little as possible, as it corrodes the skin.

Caustic soda resembles caustic potash, and the same remarks apply.

Note.—In all formulæ the metric weights are not equivalents of the British item for item, but each formula gives a solution of the same composition.

The following are a few of the typical formulæ generally employed for development, etc. :—

Amidol.

(*Diamidophenol*, made in Great Britain as *Amidol-Johnson's*.)

A normal developer consists of :—

Amidol	2—3 grs.	4·5—7 gms.
Sodium sulphite	25 grs.	57·5 gms.
Water to	1 oz.	1,000 c.c.s.

The mixed developer will keep well in solution for about a week, or sometimes longer, if it is made *not stronger* than given above. It must be made up with freshly dissolved sulphite, as this salt does not keep well in solution for more than a few weeks. A sodium sulphite solution that has had added to it some potassium metabisulphite will, however, keep well for a very long period, and by the addition of dry amidol a fresh developer can be rapidly prepared when required. Make the following stock neutralised sulphite solution :—

NEUTRAL STOCK SULPHITE.

Sodium sulphite	4 ozs.	200 gms.
Potassium metabisulphite	$\frac{1}{2}$ oz.	25 gms.
Water to	20 ozs.	1,000 c.c.s.

It is *best* to boil this mixture after having dissolved the chemicals in moderately hot water. Boiling is not essential, but it improves the keeping qualities of the solution.

DEVELOPER.

Amidol	40—60 grs.	2—3 grs.	4·5—7 gms.
Stock sulphite sol.	4 ozs.	100 minims	200 c.c.s.
Water to	20 ozs.	1 oz.	1,000 c.c.s.

Amidol is an excellent non-staining developer, giving detail at first and density afterwards. Suitable for plates, papers and lantern slides.

Azol.

The following are the instructions for the use of this single-solution developer:—

For Plates and Films:—

Normal exposures:	Azol	20 mins.	$\frac{1}{2}$ oz.
	Water.. ..	to 1 oz.	to 6 ozs.
Under-exposures:	Azol	15 mins.	$\frac{1}{2}$ oz.
	Water.. ..	to 1 oz.	to 8 ozs.
Over-exposures:	Azol	30 mins.	$\frac{1}{2}$ oz.
	Water.. ..	to 1 oz.	to 4 ozs.

For stand development:—Azol, 1 oz.; water, 100 ozs.

For tank development:—Azol, $\frac{1}{2}$ oz.; water, 40 ozs. Time of development of films at 60 deg. F., 20 to 30 minutes. This solution may be used several times in succession.

For lantern slides and transparencies:—Azol, 25 mins.; potass. bromide 10%, 5 mins., water to 1 oz.

For bromide papers:—Azol, 15 mins.; water to 1 oz. A few drops of 10% solution potass. bromide may be added if the whites are grey.

For gaslight papers:—Azol, 40 mins.; water to 1 oz. Add a few drops of 10% solution of potass. bromide, sufficient to keep the whites clear.

Diamidophenol.

See Amidol.

Ferrous Oxalate.

This developer is rarely used now: it calls for greater exposure of the plate. But it is unique in the perfectly clear grey stainless negatives which it yields.

A.—Potass. oxalate (neutral), 5 ozs.; hot water, 20 ozs. Cool, and pour off clear liquid for use.

B.—Warm water, 20 ozs.; sulphuric acid, 30 minims; sulphate of iron, 5 ozs.

Mix 1 oz. of B. with 3 to 4 ozs. of A (pouring B into A, not *vice versa*).

A more powerful developer is made by dissolving commercial dry ferrous oxalate in boiling saturated solution of potassium oxalate. As much as will dissolve is stirred in, and the whole left to cool, after which the clear solution is poured off for use.

FOR TRANSPARENCIES ON GELATINO-CHLORIDE PLATES.

A.—Neutral oxalate of potash	..	2 ozs.	100 gms.
Ammonium chloride	..	40 grs.	4.5 gms.
Distilled water	..	20 ozs.	1,000 c.c.s.
B.—Sulphate of iron	..	4 drs.	34 gms.
Citric acid	..	2 drs.	17 gms.
Alum	..	2 drs.	17 gms.
Distilled water	..	16 ozs.	1,000 c.c.s.

For black tones, mix the above in equal volume.

HURTER AND DUFFIELD'S STANDARD FERROUS OXALATE DEVELOPER.

(The Photographic Journal, 1898.)

A.—Potassium oxalate	1 part
Water	4 parts
B.—Ferrous sulphate	1 part
Citric acid .. .	0.01 part
Water	3 parts
C.—Potass. bromide	1 part
Water	100 parts

For use take A, 100 parts; B, 25 parts; C, 10 parts. Development to be conducted at a temperature of 65 deg. F.

The ferrous oxalate as compounded above contains in every 1,000 parts:—Potassium oxalate, 185 parts; ferrous sulphate, 68.5 parts; citric acid, 0.61 part; potassium bromide, 0.74 part.

Glycin.

ONE-SOLUTION (HÜBL).

Boiling water	4 ozs.	1,000 c.c.s.
Sodium sulphite	2½ ozs.	625 gms.
When dissolved add—		
Glycin	1 oz.	250 gms.

And then in small quantities—

Potass. carbonate	5 ozs.	1,250 gms.
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This forms a thick cream, which must be well shaken and then diluted with water; for normal work, dilute 1 oz. with 12 or 15 ozs. of water; for very soft results with 30 ozs. of water.

ONE-SOLUTION.

Glycin	1 oz.	33 gms.
Sodium sulphite	2½ ozs.	83 gms.
Potass. carbonate	5 ozs.	166 gms.
Water to	30 ozs.	1,000 c.c.s.

For normal exposures dilute with an equal bulk of water.

Glycin is a slow-acting developer which keeps for a very long time and yields negatives perfectly free from stain.

Hydroquinone.

Made up with soda carbonate (as per the first formula below) hydroquinone is a rather slow-acting developer. The caustic-soda formula is quicker, but easily gives excessive density and contrast; it is best suited for line drawings or subjects where full contrast is required.

ONE-SOLUTION.

Hydroquinone	100 grs.	11.5 gms.
Sodium sulphite	1½ ozs.	75 gms.
Sodium carbonate	3 ozs.	150 gms.
Water to	20 ozs.	1,000 c.c.s.

May be diluted with an equal volume of water.

This formula is not so quick in action as the next one, but there is less tendency for the great density in the high-lights which is easily produced in cases of under-exposure. In all cases the temperature of the hydroquinone developer should not be allowed to fall below 60 deg.; or the solution becomes inert.

TWO-SOLUTION (CAUSTIC SODA).

A. Hydroquinone ..	160 grs.	18 gms.
Sodium sulphite ..	2 ozs.	100 gms.
Citric acid ..	60 grs.	7 gms.
Potass. bromide ..	40 grs.	4.5 gms.
Water to	20 ozs.	1,000 c.c.s.
B.—Caustic soda (stick)	160 grs.	18 gms.
Water to	20 ozs.	1,000 c.c.s.

For use:—A, 1 oz.; B, 1 oz.; water, 2 ozs.

ONE-SOLUTION (WITH FORMALINE).

Hydroquinone	130 grs.	15 gms.
Sodium sulphite	6 ozs.	300 gms.
Formaline	3 drs.	20 c.c.s.
Water to	20 ozs.	1,000 c.c.s.

A slow developer, giving great clearness in the shadows and plenty of density in high-lights, and specially suitable for line-subjects.

Metol.

(See *Monomet and Scalol*.)

Metol-Hydroquinone (M.Q.).

(See *Monomet-Hydroquinone and Scalol-Hydroquinone*.)

Monomet.

(British-made developer of White Band Manufacturing Co., replacing metol.)

(FOR SOFT NEGATIVES.)

Monomet	20 grs.	2.2 gms.
Soda sulphite, cryst.	240 grs.	28 gms.
.. carbonate, cryst.	240 grs.	28 gms.
Potass. bromide 10 % solution ..	20 to 40 minims	2 to 4 c.c.s.
Water	20 ozs.	1,000 c.c.s.

This may be made up in bulk as follows:—Monomet, 80 grs.; soda sulphite, cryst., 2 ozs.; soda carbonate, cryst., 2 ozs.; potass. bromide, 1 to 2 drams; water, 80 ozs.

For use with plates and films, 1 part of the stock solution is mixed with 1 part of water to form the working developer.

Monomet-Hydroquinone.

Monomet	16 grs.	2 gms.
Hydroquinone	32 grs.	4 gms.
Sodium sulphite, cryst. ..	240 grs.	28 gms.
Soda carbonate, cryst. ..	240 grs.	28 gms.
Potass. bromide 10% solution	20 minims	2 to 4 c.c.s.
Water	20 ozs.	1,000 c.c.s.

For use in bulk the formula may be made up as follows:—Monomet, 64 grs.; hydroquinone, 120 grs.; soda sulphite cryst., 2 ozs.; soda carbonate, cryst., 2 ozs.; potass. bromide, 1 dram; water, 80 ozs.

For negative one part of this stock solution is mixed with one part of water to form the working developer.

Formula for Tank Development.

Monomet	3½ grs.	0.4 gm.
Hydroquinone	9 grs.	1.2 gm.
Soda sulphite, cryst. ..	¾ oz.	40 gms.
Soda carbonate, cryst. ..	70 grs.	8 gms.
Potass. bromide 10% solution	5 drops	0.6 c.c.
Water	20 ozs.	1,000 c.c.s.

With this formula development is complete in about 20 minutes.

Monomet-Pyro.

A.—Monomet .. .	20 grs.	2.2 gms.
Pyrogallie acid .. .	40 grs.	4.5 gms.
Potass. metabisulphite	100 grs.	10 gms.
Water	20 ozs.	1,000 c.c.s.
B. -Soda carbonate .. .	800 grs.	90 gms.
Potass. bromide .. .	16 grs.	2 gms.
Water	20 ozs.	1,000 c.c.s.

Equal parts of A and B are mixed to form the working developer.

Paramidophenol.*ONE-SOLUTION.*

Potassium metabisulphite ..	6 ozs.	300 gms.
Distilled water (boiling) ..	20 ozs.	1,000 c.c.s.
Paramidophenol	2 ozs.	100 gms.

Dissolve in the above order and add gradually—

Caustic soda or potash q.s.
to dissolve the precipitate first formed.

For use, dilute 1 oz. with from 10–30 ounces of water.

Paramidophenol is stainless and keeps well in single solution, owing probably to its preservative action on soda sulphite.

TWO-SOLUTION.

A.—Paramidophenol hydrochloride	200 grs.	23 gms.
Potassium metabisulphite	100 grs.	11.5 gms.
Distilled water to.. ..	20 ozs.	1,000 c.c.s.
B.—Sodium sulphite	1½ oz.	62.5 gms.
Potassium carbonate	1½ oz.	62.5 gms.
Distilled water to.. ..	ozs.	1,000 c.c.s.

For use, mix 1 oz. of A with 2 ozs. of B.

Pyro-Soda Developer.

(The "B.J." Formula.)

Make up two solutions according to the following formula—

A.—Pyro	1 oz.	50 gms.
Soda sulphite, cryst... ..	8 ozs.	400 gms.
or anhydrous	4 ozs.	200 gms.
Potass. metabisulphite	1 oz.	50 gms.
Water	60 ozs.	3,000 c.c.s.
B.—Soda carbonate, cryst.	12 ozs.	600 gms.
or anhydrous	4½ ozs.	225 gms.
Water	60 ozs.	3,000 c.c.s.

Mix A, 1 part ; B, 1 part ; water, 2 parts.

In making the A solution the sulphite and metabisulphite should be mixed together dry and put together into hot water. When they are dissolved, the solution should preferably be brought to the boil and boiled for about a minute, after which the pyro is dissolved—when the solution is cooled. The boiling greatly improves the keeping qualities of the solution.

If preferred the sulphite and metabisulphite can be dissolved in only half the water and the necessity of heating or boiling so much solution thus avoided. The second half can be added cold and the pyro then dissolved.

This developer will produce negatives free from pyro stain, and 4 to 6 minutes' development at normal temperature with full exposure will yield soft negatives full of detail and well suited to enlarging. The advantages of the developer are its cleanliness and the extraordinary keeping qualities of the A solution which must be made up as directed above.

When stronger negatives are required the developer can be made up by taking equal parts of A, of B, and of water, or equal parts of A and B alone can be used, this giving a developer containing about 4 grains pyro to the ounce.

The mixed solution can be used for several plates in succession if a little extra time is given for development in each case.

Ordinary Formula.

The following is a formula for the pyro-soda developer on the lines recommended by most of the British plate makers, *i.e.*, with metabisulphite only as the preservative of the pyro in the A solution,

with sulphite in the B solution in amount generally equal to that of the soda carbonate therein :—

A.—Potass. metabisulphite	..	..	30 grs.	3.5 gms.
Water..	..	..	20 ozs.	1,000 c.c.s.
Pyro ..	..	..	1 oz.	12.5 gms.
B.—Soda carbonate, cryst.	..	..	2 ozs.	100 gms.
Soda sulphite, cryst.	..	..	2 ozs.	100 gms.
Potass. bromide	..	..	10 grs.	1 gm.
Water..	..	..	20 ozs.	1,000 c.c.s.

Mix equal parts of A and B.

The Hurter and Driffield standard pyro-soda developer for plate speed testing is :—

Pyro	..	..	..	..	8 parts.
Sodium carbonate	..	..	..	..	40 parts.
Sodium sulphite	..	..	..	..	40 parts.
Water to	..	..	..	..	1,000 parts.

Pyro-Ammonia.

(10% SOLUTIONS.)

A.—Pyro	..	..	1 oz.	100 gms.
Potass. metabisulphite*	..	..	1 oz.	100 gms.
Water to make	..	..	9 ozs.	1,000 c.c.s.
B.—Potass. bromide	..	..	1 oz.	100 gms.
Distilled water to	..	..	9 ozs.	1,000 c.c.s.
C.—Liquid ammonia (0.880)	..	..	1 oz. (fl.)	100 c.c.s.
Distilled water to..	..	..	9 ozs.	1,000 c.c.s.

To make a normal developer, take A, 20 minims ; B, 10 minims ; C, 30 minims ; water to 1 oz. ; or if no bromide is used, A, 20 minims ; C, 10 minims ; to water, 1 oz. ; or in metric measures, A, 2 c.c.s. ; B, 1 c.c. ; C, 3 c.c.s. ; water to 50 c.c.s.

Pyro-Caustic Soda.

(VALENTA.)

A.—Pyro	..	..	220 grs.	25 gms.
Soda sulphite	..	..	3½ ozs.	162.5 gms.
Water to	..	..	20 ozs.	1,000 c.c.s.
B.—Caustic potash	..	..	100 grs.	11.5 gms.
or				
Caustic soda	..	..	70 grs.	8.5 gms.
Water to	..	..	20 ozs.	1,000 c.c.s.

Take A, 1 oz. ; B, 1 oz. ; water, 1 oz.

The above is a quick-acting and cheap developer, resembling metol in its characteristics.

Pyro-Metol.

(See Monomet-Pyro and Pyro-Scalol.)

*Or Soda sulphite	4 ozs.	400 gms.
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Pyro-Scalol.

A.—Potass metabisulphite	50 grs.	5.7 gms.
Pyro	30 grs.	3.4 gms.
Scalol	20 grs.	2.3 gms.
Water	20 ozs.	1,000 c.c.s.
B.—Soda carbonate, recryst ..	4 ozs.	200 gms.
or anhydrous	1½ ozs.	75 gms.
Soda sulphite, recryst. ..	1 oz.	50 gms.
or anhydrous	½ oz.	25 gms.
Water (warm)	20 ozs.	1,000 c.c.s.

The chemicals are dissolved in warm water in the order named; the solution is ready for use when cold.

To mix the working developer take equal parts of A and B.

Pyro-Acetone.

A.—Pyro.. ..	1 oz.	100 gms.
Sodium sulphite ..	4 ozs.	400 gms.
Distilled water to..	9 ozs.	1,000 c.c.s.

Potassium metabisulphite must not be used, unless neutralised, and there should be no addition of citric acid.

A normal developer consists of:—

A. sol (= pyro, 4 grs. or 8 gms.)	40 minims	80 c.c.s.
Acetone	40 minims	80 c.c.s.
Water	1 oz.	1,000 c.c.s.

and is made by measuring out 40 minims of A solution, adding 40 minims of acetone and making up to 1 oz.

Pyrocatechin.**TWO-SOLUTION.**

A.—Pyrocatechin	175 grs.	20 gms.
Sodium sulphite	1½ oz.	75 gms.
Water	20 ozs.	1,000 c.c.s.
B.—Potass. carbonate	2½ ozs.	125 gms.
Water	20 ozs.	1,000 c.c.s.

Equal parts are mixed together.

ONE-SOLUTION.

Sodium sulphite	5 ozs.	250 gms.
Water	20 ozs.	1,000 c.c.s.
Caustic soda	260 to 300 grs.	30 to 34.5 gms.
Pyrocatechin	400 grs.	46 gms.

The chemicals are dissolved in this order, and the stock solution kept well corked. It is diluted with 20 times its volume of water for use.

Scalol.

(British-Made Developer (Johnson's) Replacing Metol.)

Soda sulphite, recryst. ..	..	1 oz.	25 gms.
or anhydrous .. ..	..	110 grs.	12.5 gms.
Scalol .. ..	..	20 grs.	2.3 gms.
Soda carbonate, recryst. ..	..	1 oz.	50 gms.
or anhydrous .. ..	..	168 grs.	19 gms.
Potass. bromide .. ..	..	4 grs.	0.5 gm.
Water, warm .. ..	..	20 ozs.	1,000 c.c.s.

Dissolve the chemicals in warm water in the order named; the developer is ready for use when cold.

This solution is suitable for use with plates, films, or papers.

Scalol-Hydroquinone.

ONE-SOLUTION.

Soda sulphite, recryst. ..	..	1 oz.	50 gms.
or anhydrous .. ..	..	1 oz.	25 gms.
Scalol .. ..	..	20 grs.	2.5 gms.
Hydroquinone .. ..	..	40 grs.	4.5 gms.
Soda carbonate, recryst. ..	..	1 1/2 ozs.	75 gms.
or anhydrous .. ..	..	250 grs.	28 gms.
Potass. bromide .. ..	..	5 grs.	0.5 gm.
Water (warm) .. ..	..	20 ozs.	1,000 c.c.s.

Dissolve the chemicals in warm water in the order named and use when the solution is cold.

All descriptions of work, negatives on plates and films, and bromide and gaslight papers; the above stock solution is mixed with an equal bulk of water.

Factorial Development.

The total time of development (found by trial to give a certain amount of contrast) divided by the time in which the image first appears is the "factor" of a developer.

The following "Watkins' factors" are abstracted from the instructions from the "Watkins' dark room clock and factoria calculator":—

SUGGESTED FACTORS.			Grs. pyro. brom. Fac-		
	Grs. pyro to oz.	Fac-tor.		to oz. to oz. tor.	
Pyro-soda without bromide	1	18	Pyro-soda	1	9
	2	12	with bromide	1 1/2	5
	3	10		2	4 1/2
	4	8		2 1/2	4
	5	6 1/2		3	3 1/2

Pyro-acetone—about double the above figures.

	Fac or.		Factor.
Amidol (2 grs. per oz.) ..	18	Imperial pyro-soda	
Diamidophenol	60	Imperial Standard (pyro-	
Diogen	12	metol)	9
Hydroquinone (min. bromide) 5		Kodak powders	18
Hydroquinone (max. bromide) 4½		Metol (Monomet, Scalol,	
Ilford pyro-soda (maximum		etc.)	30
pyro)	4½	M.Q.	14
Ilford pyro-soda (minimum		Pyrocatechin	10
pyro)	5½	Quinomet	30

Note.—High-factor developers (*e.g.*, diamidophenol and Azol), owing to the long time which is needed for density, tend to softness. Short-factor developers (*e.g.*, hydroquinone and strong pyro-soda) tend to hardness, as they quickly build up density after the image appears.

Where a factor divides evenly into 60, the product is called a divisor, and will greatly facilitate calculating the total time of development. Thus Diogen has a divisor of 12 (60 divided by 5), and if the time of appearance in *seconds* is divided by 12 the result is the number of *minutes* to develop.

PYRO-SODA DEVELOPERS.

With and without bromide.

	Factor.		Factor.
Austin-Edwards (with B) ..	5	Marion (with B)	4½
Barnet (with B)	4½	Mawson (no B)	10
Cadett (no B)	9	Paget (no B)	11
Kodak (no B)	12	Thomas (with B)	5
Edwards (with B)	4½	Wratten (no B)	11
Premier (with B)	4½	Wellington (normal) ..	11
Gem (with B)	4	Wellington (studio) ..	15

Restrainers.

Potassium bromide in 10 per cent. solution is the most common restrainer. The dose is from one half-grain (5 minims) per ounce of developer.

Ammonium citrate solution has the advantage that after it has been added to the developer density can be obtained without further fogging, though the development of detail is prevented. An average dose with the pyro-ammonia developer is 6 to 10 grains per ounce (60 to 100 minims of solution made by adding ammonia, about 250 minims, to 1 ounce of citric acid dissolved in a little water until neutral, and diluting the whole to 10 ounces).

Potassium borotartrate.—10 to 30 minims of a 10 per cent. solution restrain with most developers.

Sodium bicarbonate acts as a restrainer, particularly with amidol developer.

FIXING, & HYPO ELIMINATORS.

The Hypo Fixing Bath.

In making up the fixing bath cold water should not be used: the hypo greatly chills the water as it dissolves, and hinders the process. There is no harm in using even very hot water if the bath is cold before use.

The average strength of hypo for fixing negatives is 4 ozs. per 20 ozs. It should not be less, but may be more—5, 6 or 8 ozs.

A convenient method of keeping hypo is: dissolve each pound in about a pint of water (hot), cool and make up to 32 ozs. in all. Every 2 ozs. of this stock solution equals 1 oz. hypo. It is used as follows to make up baths of various strength:—

Hypo, required per 20 ozs. of fixing bath.		Mix, of stock solution,	Water.	
8 ozs.	..	16	with	4 i.e., stock, 4; water, 1.
6 ozs.	..	12	with	8 i.e., stock, 3; water, 2.
5 ozs.	..	10	with	10 i.e., equal parts.
4 ozs.	..	8	with	12 i.e., stock, 2; water, 3.
3 ozs.	..	6	with	14 i.e., stock, 3; water, 7.
2 ozs.	..	4	with	16 i.e., stock, 1; water, 4.

In fixing plates, observe three golden rules:—

1.—Let plates remain in fixer as long again as it takes for the white emulsion to dissolve away.

2.—Always rinse fingers under tap or in a dish of water after touching hypo, not simply wipe on a towel.

3.—Avoid letting hypo droppings dry up on table or floor. If hypo solution drops or is splashed or spilt about the dark room, mop it up with a floor cloth and leave all clean.

Acid Fixing Baths.

Hypo	..	..	..	4 to 6 ozs.	200 to 300 gms.
Potass. metabisulphite	..	..	..	$\frac{1}{2}$ oz.	25 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

The metabisulphite should be added only when the hypo solution is cool or tepid—not when it is hot.

This is the best formula we know for an acid fixing bath for plates or papers. It keeps clear and stainless to the last, and does not throw down sulphur with use.

The following is a cheaper bath:—

Hypo solution (1:5)	50 ozs.	1,000 c.c.s.
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To which add a mixture of—

Tartaric acid solution (1:2)	..	$1\frac{1}{2}$ oz.	30 c.c.s.
Sodium sulphite solution (1:4)	..	$3\frac{1}{2}$ ozs.	70 c.c.s.

Alum-Hypo Fixing Bath.

Alum (saturated solution)	..	20 ozs.	1,000 c.c.s.
Sodium sulphite (saturated solution)	.. ..	4—7 ozs.	200-300 c.c.s.
Hypo-solution (1:5)	.. ..	20—28 ozs.	1,000-1,250 c.c.s.

Chrome Alum and Hypo Fixing Bath.

Add—			
Strong sulphuric acid	.. ..	2 dr. (fl.)	10 c.c.s.
Water	.. ..	2 ozs.	80 c.c.s.
to—			
Sodium sulphite	.. ..	2 ozs.	80 gms.
Water	.. ..	6 ozs.	240 c.c.s.
And pour the mixture into—			
Hypo	.. ..	16 ozs.	700 gms.
Water	.. ..	48 ozs.	2,000 c.c.s.
Finally add to the above mixture—			
Chrome alum	.. ..	1 oz.	40 gms.
Water	.. ..	8 ozs.	300 c.c.s.

Removing Hypo by Washing.

In washing negatives in running water or frequent changes, over 90 per cent. of the hypo is cleared away in less than ten minutes. To remove the remainder, by a washer or hand method, it is essential to drain off *all* the water in which the negative has soaked. The best washers are those which alternately empty and refill, and the same principle should be followed when washing in dishes. If this is done there is no need to wash negatives longer than an hour at the outside.

Hypo-eliminators are chemicals which convert the hypo into some other substance, but as it is not certain into what, this chemical method of removing hypo is not so reliable as removal by washing. But we give three formulæ.

Hypo-Eliminators.**PERMANGANATE.**

Wash the negative for one minute under the tap, and transfer to a shallow dish containing water with enough potass. permanganate in it to turn it pink. Remove the negative as soon as the colour goes (which will be in a second or two if hypo is present), and keep on treating in the very weak permanganate baths until the colour is not discharged. The water itself will destroy the permanganate colour, but not quickly as hypo does. A very cheap and satisfactory process which allows of a negative being ready for drying within three minutes of fixation.

PERSULPHATE.

Ammonium persulphate	.. ..	2½ grs.	6 gms.
Carbonate of soda	.. ..	5 grs.	12 gms.
Water	.. ..	1 oz.	1,000 c.c.s.

PERCARBONATE.

Potassium percarbonate	2½ grs.	6 gms.
Water	1 oz.	1,000 c.c.s.

Rapid Drying of Negatives.

Method I.—Rinse from the hypo-bath, place in 1 : 50 formaline for ten minutes, wash by pouring nearly boiling water six times over the negative and dry by heat. To get rid of the relief which is produced by this process the negative is rubbed with a piece of wash-leather moistened with alcohol.

Method II.—After washing in the usual way or using a hypo-eliminator, lay a piece of old fine cambric on the negative and firmly pass a roller squeegee over it. The negative, with much of the water thus removed, will dry in a few minutes in a moderately warm place.

Method III.—Soak in two successive baths of methylated spirit, and place in a current of air. The present commercial spirit, owing to the mineral naphtha in it, causes a whitish scum on the surface of the film, and is not favourable to clean work.

Method IV.—Electric hot blast—by means of a blower of the kind used by hairdressers, and capable of giving a temperature of from 68° to 125° F., within from 4 to 6 minutes, according to the distance of the blower from the rack of negatives—3 ft. to 1 ft.

HARDENING AND CLEARING SOLUTIONS.

As a general rule, there is no need to use a bath of alum; frilling or softening of the films of plates is seldom met with—that is, in temperate latitudes. When it does occur, it is most usually the result of baths (developing, fixing, etc.) being of very different strengths or at different temperatures.

If a plate *should* show signs of frilling in the developer, it should be rinsed for an instant and placed in one of the hardening baths, given below, then washed for ten minutes before fixing. This is better than hardening *after* fixing.

Hardening Baths.

Formaline	1 oz. fluid.	50 c.c.s.
Water	10 to 20 ozs.	500-1,000 c.c.s.
Alum	1 oz.	50 gms.
Water	20 ozs.	1,000 c.c.s.
Chrome alum	1 oz.	50 gms.
Water	20 ozs.	1,000 c.c.s.

Whichever bath is used, allow it to act for 15 or 20 minutes.

In making up the chrome alum bath, use cold or warm, not hot, water.

Clearing Solutions.

ACID ALUM.

Alum	..	..	2 ozs.	200 gms.
Citric acid	..	..	1 oz.	100 gms.
Water	..	..	10 ozs.	1,000 c.c.s.

Wash well after fixing, and immerse the negative in the above. This bath is also useful for removing white scum from negatives developed with ferrous oxalate if rubbed on with cotton wool.

CHROME ALUM.

Chrome alum	..	..	$\frac{1}{2}$ oz.	25 gms.
Hydrochloric acid..	..	..	$\frac{1}{2}$ oz.	25 c.c.s.
or				
Citric acid	..	..	1 oz.	50 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

We prefer this latter bath for the final treatment of negatives, and for obtaining a clean smooth film.

THIOCARBAMIDE.

Thiocarbamide	..	..	90 grs.	10 gms.
Citric acid	..	..	90 grs.	10 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

SODIUM HYPOCHLORITE.

(Eau de Javelle.)

This bath need only be resorted to in cases of severe stain, particularly on old negatives.

Bleaching powder..	..	..	1 oz.	30 gms.
Sodium carbonate..	..	..	$1\frac{1}{2}$ oz.	45 gms.

Shake up the bleaching powder with a solution of the carbonate in a little water (6 ozs. or 180 c.c.s.), and filter. Extract the residue with plain water, and again filter. The filtrate (solution of sodium hypochlorite) forms an active stain remover. It can be acidified with oxalic acid, and then discharges yellow stain still more vigorously, but with risk to the silver image.

N.B.—In either state (alkaline or acid) the solution has a strong softening action on gelatine. Plates should not be left to soak longer than necessary—which should be 10 to 15 minutes as a rule.

REMOVING SILVER STAINS.

Most silver stains (due to dampness of paper or negative while the two are in contact) will readily yield to the following simple treatment first suggested by Mr. Harold Baker:—

Rub the dry negative with Globe metal polish (or other similar abrading preparation) for a minute or two. This is done by applying the polishing paste on a tuft of cotton wool. Then place negative in very strong hypo solution. Here the stain disappears; the time may be minutes or hours according to the depth and age of the stain.

In very severe cases the following method may be necessary :—
Soak the negative in—

A.—Potass. iodide	..	..	..	200 grs.	45 grms.
Water	..	..	..	10 ozs.	1,000 c.c.s.

and after washing transfer to—

B.—Potass. cyanide	..	..	..	300 grs.	70 grms.
Water	..	..	..	10 ozs.	1,000 c.c.s.

in which rub the stained part of the film with a pledget of cotton wool.

If the stain does not yield to this treatment a solution of iodine (in potass. iodide) may be used in place of solution A.

NEGATIVE REDUCERS.

Reduction is useful if the negative is so dense (black) that it takes long to print. Also, apart from reducing time of printing, reduction is used to improve the gradation of negatives.

For those which are too hard, usually as the result of under-exposure and too long development, the best reducer is the per-sulphate. The permanganate and bichromate are similar in their effect.

For those which, though dense, yield prints which are too flat—this is the result of great over-exposure and long development—the best is Farmer's. Belitski's is similar.

Even when density is not excessive, it is usually well, in the case of flat negatives, to reduce a little in "Farmer's," and then intensify.

The other reducers—Eder's, iodine-cyanide, and ceric sulphate—are used chiefly when it is desired somewhat to reduce negatives of good gradation.

Farmer's.

This reducer tends to remove detail in the shadows whilst leaving untouched the dense high-lights. Hence it increases contrast: "brightens up" a negative.

Hypo solution (1 : 5)	..	..	5 ozs.	150 c.c.s.
Potass. ferriocyanide (10% sol.)	..	quant. suff.	quant. suff.	quant. suff.

The colour is a fair indication of the strength of the reducer; it should be pale yellow, not orange, and should be used weak rather than strong, since its selective action on the shadows of a negative is then less.

Yellow stain is due usually to the use of an acid fixing bath, or an old fixing bath, instead of clean plain hypo solution. It is not easy to remove.

If the reduction is required as "even" as possible, that is, less pronounced on the shadows of the subject in the negative, use the reducer very weak, viz.: largely diluted with water.

Where the extreme of contrast is required, use a strong reducer, applying it with cotton wool, not too wet with reducer. Very useful for line negatives, where quite clear lines on a dense ground are wanted.

Belitski's.

Potass. ferric oxalate	.. ..	150 grs.	10 gms.
Sodium sulphite	125 grs.	8 gms.
Water..	7 ozs.	200 c.c.s.

Dissolve and add—

Oxalic acid..	40 to 45 grs.	2.5 to 3.1 gms.
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and shake until the solution turns green. Then pour off from undissolved crystals and add—

Hypo	1½ oz.	50 gms.
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Instead of the ferric oxalate the following more easily obtainable chemicals can be used in the formula:—

Ferric chloride cryst.	.. ..	100 grs.	6.5 gms.
Potass. oxalate	.. ..	190 grs.	12.5 gms.

This reducer is stainless, and keeps well in the dark. Its action on the shadow detail of the negative is similar to that of Farmer's.

Persulphate.

Ammonium persulphate..	.. ..	10 to 20 grs.	23 to 45 gms.
Water	.. ..	1 oz.	1,000 c.c.s.

A fresh solution is made at time of use. A drop of sulphuric acid per 2 ozs. makes the action more regular. It is best also to use the reducer before the negative has dried.

When sufficiently reduced—indeed, slightly before—the negative is placed at once into 5 per cent. sodium sulphite solution.

If much reduction has taken place it is well to fix a second time. The persulphate reducer acts first on the heavy high-light densities of the negatives, reducing these without affecting shadow detail. It thus "softens" a hard negative.

Eder's (Mercury and Cyanide).

Potassium cyanide	.. ..	20 grs.	5 gms.
Potassium iodide	.. ..	10 grs.	2 gms.
Mercury bichloride	.. ..	10 grs.	2 gms.
Water	.. ..	10 ozs.	1,000 c.c.s.

Dissolve the mercury, then the iodide, and lastly the cyanide to dissolve the red precipitate formed. The solution reduces slowly, and is non-staining and intensely poisonous.

Iodine-Cyanide.

Iodine (10 per cent. sol. in potass. iodide sol.)	.. ..	30 minims	6 c.c.s.
Potass. cyanide (10 per cent. sol. in water) ..	.. ..	5 minims	1 c.c.s.
Water	.. ..	1 oz.	100 c.c.s.

A very clean-acting (but intensely poisonous) reducer. Very suitable, when used quite weak, for bromide prints, as it leaves no stain.

Ceric Sulphate.

Sulphuric acid (sp. gr. 1.84) ..	20 minims	4 c.c.s.
Water	2 ozs.	200 c.c.s.
Dissolve in this—		
Ceric sulphate	1 oz.	100 gms.
And dilute to—		
Water	10 ozs.	1,000 c.c.s.

Hard negatives are placed wet in a mixture of this stock solution and nine times its volume of water. Reduces contrasts. Over-exposed, long-developed negatives are dipped dry into a mixture of stock solution and an equal part of water and carefully watched, as the action is very rapid. A convenient form of the reducer is the stock solution sold by Lumière.

Permanganate.

Potass. permanganate, 10% solution	1 dr.	10 c.c.s.
Sulphuric acid (10% solution by volume of 1.84 acid)	5 drs.	50 c.c.s.
Water	10 ozs.	1,000 c.c.s.

Applied to a wet negative, gives even reduction. A dry negative receives greater reduction in the high-lights, and great softening may be obtained by immersing dry negative quickly in the reducer, washing immediately, drying and re-immersing. Any brown stains are removed with a 10% solution of sodium sulphite containing 2% oxalic acid.

Bichromate.

Potass. bichromate	100 grs.	20 gms.
Sulphuric acid	7 drs. (fl.)	40 c.c.s.
Water	20 ozs.	1,000 c.c.s.

Hypochlor and Alum.

Chrome alum	10 grs.	4 gms.
Eau de Javelle	$\frac{1}{2}$ oz.	100 c.c.s.
(See "Clearing Solutions")		
Water to make	5 ozs.	1,000 c.c.s.

Immerse the negative and gently rub the surface with a piece of cotton wool. By confining friction with the wool to certain parts, extra reduction can be obtained.

Reducing Hard Negatives.

A most valuable and perfectly safe method of reducing excessively hard negatives is one dependent on re-development. Bleach the negative first in a solution of ferricyanide and potassium bromide, using the same bath as is commonly employed for sulphide toning. After a thorough wash re-develop in a developer containing 2 per cent. of rodinal and 1 per cent. of potassium bromide—that is, one containing 1 dram of rodinal and 5 drams of 10 per cent. bromide solution in 6 ozs. of water. Development will be very slow, but the

plate may be left to itself for half an hour or so, as the action cannot go too far. When development is sufficient the plate is fixed, washed, and dried.

Baskett's (Local) Reducer.

It consists of—

Globe metal polish	..	..	..	..	2d. tin
Terebene	..	..	..	..	2 ozs.
Salad oil	..	..	..	..	2 ozs.

The ingredients are to be well mixed, and strained through fine muslin two or three times to remove any coarse particles. Dense parts of a negative are rubbed down with the reducer applied by the finger-tip or with a bit of chamois leather.

NEGATIVE INTENSIFIERS.

Negatives which are too thin (and as a rule yield flat prints) may be greatly improved by intensification.

If the negative is thin through under-exposure, that is, has not attained good density even on long development, the best intensifier is the uranium. For this, as for most intensifiers, the plate should be both thoroughly fixed and washed—one is as important as the other.

If the plate is simply under-developed—clear and bright, but thin—the chromium or the mercury and ferrous oxalate intensifier (applied more than once if necessary) or the Wellington silver intensifier is very suitable. If the plate is over-exposed, thin but veiled and flat, the mercury and ammonia intensifier is a good remedy; or it may be well first to reduce carefully with Farmer's reducer, and then (after a second thorough wash) to intensify with chromium, mercury and ferrous oxalate, Wellington, or, if plate is very flat, with Monckhoven's or the mercury and ammonia formula. The copper and lead intensifiers give great density, and are suited only for negatives of line drawings, etc., in which great general opacity and, at the same time, great clearness of the lines are required.

Mercury Intensification.

The negative is bleached in the following saturated solution of mercury bichloride:—

Mercury bichloride (corrosive sublimate)	..	..	1 oz.	62 grms.
Hot water	..	..	16 ozs.	1,000 c.c.s.

After cooling this solution and pouring off from the white feathery crystals thrown down, add—

Hydrochloric acid..	30 minims	4 c.c.s.
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After well washing, the bleached negative is blackened in one or other of the following:—

A.—Ammonia (0.880)	20 drops	20 drops
Water ..	1 oz.	30 c.c.s.

Gives great intensification and good black colour.

B.—Soda sulphite, 10 per cent. solution, made slightly acid with citric acid. Very slightly strengthens a negative.

C.—An alkaline developer, such as pyro-soda, pyro-ammonia, hydro-quinone. Gives about double the intensification of B.

D.—Schlippe's salt	200-400 grs.	20-40 gms.
Water	20 ozs.	1,000 c.c.s.

This solution must be made fresh, and gives great intensification.

E.—Ferrous oxalate developer, made as directed under "Developers." This process can be repeated as many times as desired, and gives absolutely permanent results: it deals evenly throughout with the tones in the negative.

Monckhoven's,

A.—Bromide of potassium ..	10 grs.	23 gms.
Bichloride of mercury ..	10 grs.	23 gms.
Water	1 oz.	1,000 c.c.s.
B.—Pure cyanide of potassium ..	10 grs.	23 gms.
Nitrate of silver	10 grs.	23 gms.
Water	1 oz.	1,000 c.c.s.

The silver and cyanide are dissolved in separate lots of water, and the former added to the latter until a permanent precipitate is produced. The mixture is allowed to stand 15 minutes, and, after filtering, forms Solution B.

Place the negative in A till it is white, then rinse and transfer it to Solution B. If the intensification has been carried too far, it may be reduced by treatment with a weak solution of hyposulphite of soda.

Mercuric Iodide.

A.—Mercuric chloride	175 grs.
Water	10 ozs.
B.—Potass iodide ..	1 oz.
Water	10 ozs.

Add the major part of the iodide (B) solution to that of the mercury and stir well. There should remain a considerable red precipitate. Then add the remainder of the iodide solution in small doses until the solution just clears. This forms the stock intensifier.

The solution changes the negative to a brown colour which on washing in water changes to bright orange, yielding a very great degree of intensification. For still greater intensification and black colour, pass the negative, after washing, through a bath of soda sulphide, a few grains to the ounce.

A cheaper form of this formula can be made up by using only 270 grs. of potass iodide instead of 440 as directed above. This is added to the mercury solution, forming a muddy red mixture which can be cleared by adding a few drops of hypo solution.

Lumière Formula.

Water	20 ozs.	1,000 c.c.s.
Sodium sulphite	4 ozs.	200 gms.
Mercuric iodide	90 grs.	10 gms.

The sulphite must be dissolved first. The solution keeps well in the dark.

This is a very convenient intensifier, as plates need only be rinsed for a few minutes in water on coming out of the hypo bath to be ready for intensification.

When intensified they are simply washed for a few minutes; the negative is then liable to yellow in time, but if plate is placed for a few minutes in any non-staining developer the results are quite permanent.

If mercuric iodide is not available the following may be used:—

Mercuric chloride.. ..	50 grs.	6 gms.
Water	10 ozs.	500 c.c.s.

Add 10 per cent. potass. iodide solution until precipitate first formed is redissolved. About $1\frac{1}{2}$ oz. (75 c.c.s.) will be required, and when clear, add—

Sodium sulphite	4 ozs.	200 gms.
Water to make	20 ozs.	1,000 c.c.s.

Silver Intensifiers.

J. B. B. WELLINGTON'S FORMULA (1911).

First harden the film in:—Formaline, 1 part; water, 10 parts, for five minutes. Rinse for a few minutes, and then place for *exactly one minute* in:—

I.—Potass, ferricyanide	20 grs.	2.3 gms.
Potass. bromide	20 grs.	2.3 gms.
Water	20 ozs.	1,000 c.c.s.

This causes no apparent change in the negative; if used too long it will bleach the negative and alter its gradation. Rinse again for a few minutes and intensify.

Stock Solutions.

A.—Silver nitrate	800 grs.	91.2 gms.
Water, distilled, to	20 ozs.	1,000 c.c.s.
B.—Ammonium sulphocyanide	1,400 grs.	160 gms.
Hypo	1,400 grs.	160 gms.
Water to	20 ozs.	1,000 c.c.s.

Take A, $\frac{1}{2}$ oz., and add slowly to $\frac{1}{2}$ oz. B, stirring vigorously (mixture should be clear); then add 10 % pyro solution (preserved with sulphite), 1 dram, and 10 % ammonia solution, 2 drams.

Place negative in chemically clean dish, best of glass, and pour solution over it. Silver begins to deposit in a minute or two. When intensified enough, place in acid fixer and well wash. Flat negatives may be over-intensified and then treated with Farmer's reducer.

ACID SILVER.

A.—Pyro..	..	..	..	15 grs.	3.5 gms.
Citric acid ..	..	..	..	5-10 grs.	1-2 gms.
Water ..	..	..	..	10 ozs.	1,000 c.c.s.
B.—Silver nitrate	..	..	..	10 grs.	23 gms.
Water to ..	..	..	..	1 oz.	1,000 c.c.s.

About 1 oz. (30 c.c.s.) of A is poured over the plate once or twice, about 15 drops of B solution added, and the mixture again applied. Intensification now takes place and the solution is poured off and on until sufficient. If intensifier becomes very thick and turbid, fresh should be mixed up. When dense enough the negative is rinsed, fixed and washed. Negatives (on gelatine plates) are best hardened with alum or formaline before using this intensifier, otherwise it is difficult to avoid stains.

Chromium Intensifier.

(C. Welborne Piper.)

An excellent and convenient intensifier for general work. Results permanent.

	A.	B.	C.
Potassium bichromate ..	5 grs.	10 grs.	10 grs.
Hydrochloric acid (sp. gr., 1.160)* ..	1 minim	5 minims	20 minims
Water ..	1 oz.	1 oz.	1 oz.

Bleach in A, B or C solution, wash until yellow stain is removed, and then develop with diamidophenol.

If other developer is used, it may be necessary to expose for a short time to diffused daylight (not sunlight) during development in order to get full density. Excessive exposure before development may make it difficult to obtain density.

A gives intensification about equal to mercury and ammonia; B, to that of mercury and ferrous oxalate; and C, to that of mercury and sodium sulphite.

The process may be safely applied after fixation if the plate is simply rinsed for a minute or so.

It may be repeated several times if the first application does not give enough density.

Copper Intensifier.

Gives great intensification and is best suited for line subjects.

A.—Copper sulphate	100 grs.	230 gms.
Water ..	1 oz.	1,000 c.c.s.
B.—Potass. bromide	100 grs.	230 gms.
Water to ..	1 oz.	1,000 c.c.s.

* Commercial pure " strong acid.

A and B are separately made up with hot water, mixed, and allowed to cool. The negative is bleached in the mixture, and washed for a minute or two. It is then blackened in:—

Silver nitrate	45 grs.	100 grms.
Water (distilled)	1 oz.	1,000 c.c.s.

For still greater density, the negative is well washed from silver, and an ordinary developer applied.

If too dense, after the silver, it can be placed in weak hypo solution about 10 grs. per fl. oz.) or weak potass. cyanide (about 2 grs. per fl. oz.).

Lead Intensifier.

Lead nitrate	400 grs.	46 grms.
Potass. ferricyanide	600 grs.	70 grms.
Acetic acid	3 drachms	20 c.c.s.
Water to	20 ozs.	1,000 c.c.s.*

This stock solution will keep for a long time in the dark. The negative is bleached in it, washed once *very carefully* in 10 per cent. nitric acid—the acid makes the film very tender—then in water, and then darkened in:—

A.—Sodium sulphide	1 oz.	50 grms.
Water	20 ozs.	1,000 c.c.s.

Or in—

B.—Schlippe's salt	90 grs.	10 grms.
Ammonia (0·880)	6 drachms	40 c.c.s.
Water	20 ozs.	1,000 c.c.s.

Or in—

C.—Potass. bichromate	1 oz.	100 grms.
Ammonia (0·880)	$\frac{1}{2}$ oz.	50 c.c.s.
Water	10 ozs.	1,000 c.c.s.

The lead intensifier gives very great intensification, and is suited only for line-subjects.

Uranium Intensifier.

A.—Uranium nitrate	100 grs.	23 grms.
Water	10 ozs.	1,000 c.c.
B.—Potass. ferricyanide	100 grs.	23 grms.
Water	10 ozs.	1,000 c.c.s.

The intensifier is prepared from:—A sol., 1 oz.; B sol., 1 oz.; acetic acid, 2 drachms.

The plate must be perfectly free from hypo, and after intensification be washed in several changes of *still* water until the yellow stain is gone. A 10 gr. per fl. oz. solution of ammonium sulphocyanide removes any yellow stain, and weak ammonia or sodium carbonate removes the intensification altogether, restoring the negative to its original state. A weak acetic acid bath should then be applied to the negative if the intensifier is to be again applied.

NEGATIVE VARNISHES.

Hot Varnishes.

No. 1.—Sandarac..	..	..	4 ozs.	113 gms.
Alcohol ..	..	..	28 ozs.	800 c.c.s.
Oil of lavender ..	..	..	3 ozs.	85 c.c.s.

This is a good varnish for retouching upon, and a tooth is easily obtained by rubbing.

No. 2.—Seed lac ..	..	..	2 ozs.	50 gms.
Sandarac..	..	..	2 ozs.	50 gms.
Oil of lavender ..	..	..	$\frac{1}{2}$ oz.	12.5 gms.
Castor oil ..	..	..	1 oz.	25 c.c.s.
Alcohol ..	..	..	40 ozs.	1,000 c.c.s.

To prepare a good surface for the retouching pencil, the negative after varnishing is dusted over with fine resin powder and rubbed up with the fingers.

No. 3.—White hard varnish ..	..	15 ozs.	150 c.c.s.
Rectified spirit (not me- thylated spirit) ..	..	20 to 30 ozs.	200 to 300 c.c.s.

This will be found a good and cheap varnish if durability is not required, as it is easily rubbed up for retouching upon and easily cleaned off. Very suitable for enlarged negatives that are not to be retained.

No. 4.—Bleached shellac ..	..	$1\frac{1}{2}$ ozs.	62 gms.
Mastic ..	..	$\frac{1}{2}$ oz.	13 gms.
Oil of turpentine ..	..	$\frac{1}{2}$ oz.	13 c.c.s.
Sandarac..	..	$1\frac{1}{2}$ oz.	62 gms.
Alcohol ..	..	20 ozs. (fl.)	1,000 c.c.s.

Tough, hard, and durable.

No. 5.—Sandarac ..	..	80 ozs.	160 gms.
Turpentine ..	..	36 ozs.	72 c.c.s.
Oil of lavender ..	..	10 ozs.	20 c.c.s.
Alcohol ..	..	500 ozs.	1,000 c.c.s.

This one may also be rubbed down with powdered resin, and gives a splendid surface for retouching.

No. 6.—Sandarac ..	..	1 oz.	55 gms.
Seed lac ..	..	$1\frac{1}{2}$ oz.	83 gms.
Castor oil ..	..	3 drs.	20 c.c.s.
Oil of lavender ..	..	$1\frac{1}{2}$ dr.	10 c.c.s.
Alcohol ..	..	18 ozs. (fl.)	1,000 c.c.s.

This varnish is somewhat dark in colour.

No. 7.—Best orange shellac	2½ ozs.	125 gms.
Oil of lavender or oil of turpentine	1 oz.	13 c.c.s.
Methylated alcohol	20 ozs.	1,000 c.c.s.

Keep in a warm place until dissolved; then add a large teaspoonful of whiting or prepared chalk; shake, set aside to clear, and then decant. This is specially recommended for gelatine negatives.

Cold Varnishes.

No. 1.—Celluloid	1 oz.	10 gms.
Amyl acetate	50 ozs.	500 c.c.s.

To counteract the sickly odour of amyl acetate, add a small proportion of oil of lavender.

This may be flowed over or applied with a brush to the cold negative.

No. 2.—Zanzibar copal ..	6 ozs.	30 gms.
Amber (fused) ..	1 oz.	5 gms.
Ether	60 ozs.	300 c.c.s.
Acetone	40 ozs.	200 c.c.s.
Chloroform	4 ozs.	20 c.c.s.
No. 3.—20% shellac solution	2 ozs.	160 c.c.s.
Ammonia (0·880)	3 drs.	30 c.c.s.
Methylated spirit	4 ozs.	320 c.c.s.

No. 4.—A mixture of Japanese gold size (1 part) and benzole (2 parts) forms a rather slow-drying though otherwise excellent cold varnish. The surface takes the pencil well.

SHELLAC WATER VARNISH.

Shellac	3 ozs.	100 gms.
Sodium carbonate (saturated solution)	24 ozs.	800 c.c.s.

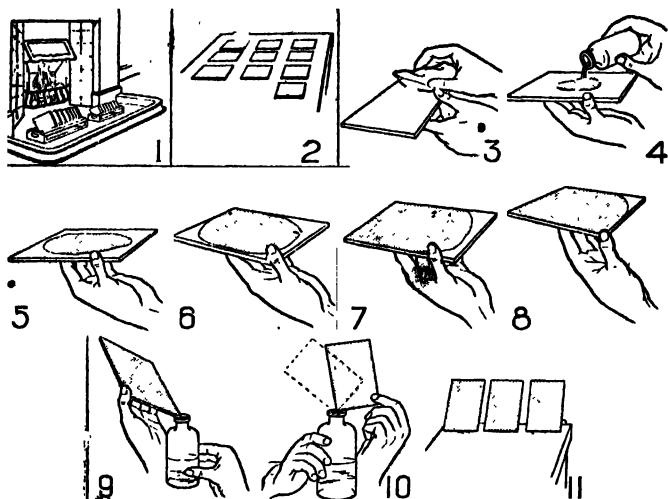
The shellac is allowed to soak in the liquid for twenty-four hours; the liquor is then poured away and replaced by an equal quantity of water, and the mixture boiled until the shellac dissolves. After standing some time the liquid becomes perfectly clear and bright.

How to Varnish Negatives.

Using Cold Varnish.

First place negatives where they will become perfectly dry, *e.g.*, near a fire (Fig. 1) or on a bath hot-water tank. Next lay out to get quite cold (Fig. 2). Remove dust with a strip of cotton plush or camel's hair brush (Fig. 3). Poise negative on the tips of fingers, steady with thumb, and pour pool of "cold" varnish (bought, or made from one of the formulæ given above), in centre (Fig. 4), using plenty. Let pool spread of itself (Fig. 5). Now incline plate to cause varnish to flow into right-hand far corner (Fig. 6); thence into left-hand far corner (Fig. 7); thence into left-hand near corner (Fig. 8), and then raise negative so as to flow excess of varnish back into bottle (Fig. 9). (N.B.—In tilting negative to distribute varnish, return plate to level position *a little before* varnish has reached the corner; the wave of

varnish will carry the coating into corners, and you will avoid getting varnish on the glass side or up your sleeve.) As last drops run into



bottle, rock negative to and fro (Fig. 10), so as to avoid a streaky coating, and as each negative is thus finished stand it on blotting-paper to dry (Fig. 11).

Film Varnishes.

The above water varnish is suitable, or the following:—

Borax	..	..	..	300 grs.	30 gms.
Glycerine	..	..	..	300 minims	30 c.c.s.
Shellac	..	..	..	600 grs.	60 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Boil together for about half an hour, then add—

Methylated spirit	5 ozs.	250 c.c.s.
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and filter.

Another good varnish for celluloid films is—

Dammar	500 grs.	115 gms.
Benzole	..	..	..	10 ozs.	1,000 c.c.s.

in which, after filtration, the films are immersed and then hung up to dry.

Retouching Medium.

Pale gum resin	..	..	..	200 grs.	230 gms.
Gum dammar	..	..	..	90 grs.	100 gms.
Gum mastic	..	..	..	20 grs.	23 gms.
Oil of juniper	..	..	..	1 gr.	1 gm.
Oil of turpentine	..	..	..	2-4 ozs.	1,000-2,000 c.c.s.

The gums are powdered and added to the oils, and finally enough pure asphaltum is added to give the mixture a dark amber colour when viewed through the depth of an inch.

This formula is strongly recommended by Whiting in his "Retouching" as not liable to pick, rub off, or come off on after-varnishing. It takes a great deal of work.

Ground-Glass Varnish.

Sandarac	..	..	..	90 grs.	103 gms.
Mastic	..	..	..	20 grs.	23 gms.
Ether (0-720)	..	..	..	2 ozs.	1,000 c.c.s.

Dissolve the resins in the ether and afterwards add—

Benzole	$\frac{1}{2}$ to $1\frac{1}{2}$ ozs.	120-700 c.c.s.
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The proportion of the benzole added determines the nature of the matt obtained.

This varnish must be applied to the cold negative or the coating will not be matt.

Malachite green, aurantia, or asphaltum is used for tinting it green yellow, or brown respectively (for handwork on back of negative).

Spotting Medium.

Indian ink	..	..	..	water colour chalk.
Payne's grey	..	..	..	water colour chalk.

Grind together with water only on a palette to match the colour of the negative.

Blocking-Out Mixtures.

No. 1.—Gamboge and vermilion red, or Payne's grey and vermilion, are ground together in water in equal parts with addition of a little gum water if a glossy surface is required.

No. 2.—Asphaltum	..	..	..	1 oz.	100 gms.
Wax	..	..	..	170 grs.	40 gms.
Carbon black	..	..	..	80 grs.	20 gms.
Turpentine	..	..	..	10 ozs.	1,000 c.c.s.

Commercial "Brunswick black" is equal to and more convenient than the above mixture.

When printing on development papers, yellow or orange dye (Vanguard yellow or Griffin's auramine) is a convenient blocking out medium which is easier in use owing to its transparency. First go over the film with ox gall on wet cotton-wool: the dye then diffuses slightly beyond the edge of the brush work and avoids harsh lines. In subjects containing detail such as ladies' hair, or drapery, a weak dye application over the outline will add the necessary density to the background without clogging the hair. Then proceed as usual, with a stronger wash when stray bits not wanted to print can be taken off without waving a sharp edge.

Titles on Negatives.

The usual method is to have the words forming the title set up in type and photographed on a "process" plate. The subject negative having been made with a clear margin round it, a strip of the title

negative is laid down on this margin by stripping and the clear margin then filled up with "photopake" or other blocking-out mixture except over the strip of title, which is made dense enough, in the first instance, to print white. If a clear portion in a landscape negative cannot be found (in cases where the title has to appear on the view), a piece must be cut out with a sharp knife.

STRIPPING.

Gelatine Glass Negatives.

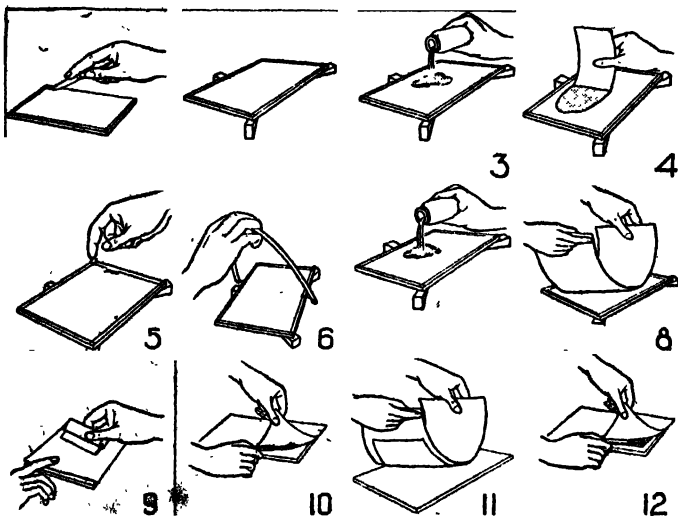
(Middleton and Holcroft.)

The following is the formula and process for stripping the film from a glass negative and transferring it (with or without reversal) to a second glass-plate or other support:

Stock solution:—

Methylated spirit ..	25 ozs.	250 c.c.s.
Water ..	1 oz.	10 c.c.s.
Glycerine	1 oz.	10 c.c.s.

To prepare the "stripping solution" 6 to 30 drops of commercial hydrofluoric acid are added to 1 oz. (30 c.c.s.) of the above.



Out through to the glass all round negative, about $\frac{1}{8}$ inch from edge, with sharp penknife (Fig. 1). Place level on three wooden

wedges (Fig. 2). Pour the "stripping solution" (prepared as above) (Fig. 3). Spread solution with an end of paper (Fig. 4). After a minute or so try (with the finger) if the edges of film are loose, and remove them as soon as they come away without any pull whatever (Fig. 5). Now test if whole film is loose by passing it stretched on a bow of cane underneath (Fig. 6). If it is free, pour on some plain "stock solution" (Fig. 7), and apply a sheet of waxed paper (Fig. 8). The waxed paper is prepared by soaking thin paper in hot melted paraffin for about half an hour. It is semi-transparent and free from buckle. Lightly squeegee down (Fig. 9), and then remove the two together in contact by slipping the blade of a penknife under the film (Fig. 10). Finally, apply the paper (Fig. 11), with the negative film on the under side, to a glass plate coated with very weak gum solution, dried and flowed over with "stock solution". Then squeegee down (Fig. 9), and remove the waxed sheet, using the blade of the penknife to keep the corner of the film to the glass (Fig. 12).

A less rapid solution, but one which will be safe in the case of an old or hardened negative, is:—

Methylated spirit..	..	..	1 oz.	80 c.c.s.
Water ..	..	..	2 ozs.	160 c.c.s.
Hydrofluoric acid ..	..	..	60 minims	10 c.c.s.

These proportions may be slightly altered for different commercial spirits and acids.

Film Negatives.

In the case of negatives on celluloid cut or roll-film the following is a suitable method:—

Caustic soda ..	..	..	10 grs.	23 gms.
Formaline ..	..	..	10 minims	20 c.c.s.
Water ..	..	..	1 oz.	1,000 c.c.s.

The celluloid negative is immersed in this solution until the film shows signs of detachment and can be rolled back with the finger. It is then placed in

Hydrochloric acid ..	..	..	25 minims	50 c.c.s.
Glycerine ..	..	..	25 minims	50 c.c.s.
Water ..	..	..	1 oz.	1,000 c.c.s.

in which it is removed from its original support to a glass or other base.

For stripping collodion negatives, see end of next section, "Wet Collodion and Collodion Emulsion."

WET COLLODION AND COLLODION EMULSION.

Wet Collodion.

PYROXYLINE (HARDWICH).

Sulphuric acid, 1.845	18 ozs. (fl.)	600 c.c.s.
Nitric acid, 1.457	5 ozs. (fl.)	200 c.c.s.
Water	5-5½ ozs (fl)	167 182 c.c.s.
Cotton-wool	300 grs.	23 gms.

Temperature 150 degrees F. (65 degrees C) Time of immersion ten minutes.

IODISED COLLODION.

For Acid Pyro Developer.

Ether, specific gravity 0.725 ..	10 ozs. (fl.)	1,000 c.c.s.
Alcohol, specific gravity 0.805 ..	4 ozs. (fl.)	400 c.c.s.
Pyroxyline	120 grs.	27 gms.
Ammonium iodide	30 grs.	7 gms.
Cadmium iodide	45 grs.	10 gms.
Alcohol (0.830)	4 ozs. (fl.)	400 c.c.s.

BROMO-IODISED COLLODION,

For Iron Developer.

Ether, specific gravity 0.725 ..	10 ozs. (fl.)	1,000 c.c.s.
Alcohol, specific gravity 0.805 ..	5 ozs. (fl.)	500 c.c.s.
Pyroxyline	120 grs.	27 gms.
Ammonium iodide	40 grs.	ms.
Cadmium iodide	40 grs.	
Cadmium bromide	20 grs.	4.5 gms.
Alcohol (0.830)	5 ozs. (fl.)	500 c.c.s.

Thinning Collodion after Use.—A mixture of sulphuric ether (0.720), 3 parts, and alcohol (0.805), 2 parts, is generally used.

THE NITRATE BATH.

Silver nitrate	6 ozs.	75 gms.
Distilled water	80 ozs. (fl.)	1,000 c.c.s.
Nitric acid (pure)	8 minims	0.2 c.c.s.

Saturate with iodide of silver, which may be done by coating a plate with collodion and leaving it in the bath for some hours. Filter.

DEVELOPER.

No. 1.—Ferrous sulphate	1 oz.	50 gms.
Glacial acetic acid	1 oz.	50 c.c.s.
Alcohol	1 oz.	50 c.c.s.
Water	10 ozs.	1,000 c.c.s.

No. 2.—Ferrous ammonio-sulphate	75 grs.	43 gms.
Glacial acetic acid	75 grs.	43 gms.
Copper sulphate	7 grs.	4
Water	4 ozs.	1,000 c.c.s.
Alcohol	$\frac{1}{2}$ oz.	60 c.c.s.

INTENSIFIER.

Pyrogalllic acid	90 grs.	10 gms.
Citric acid	60 grs.	7 gms.
Acetic acid (glacial)	1 oz.	50 c.c.s.
Water	20 ozs.	1,000 c.c.s.

The copper intensifier (see "Intensifiers") is used for greater density, each solution being flowed over the plate with a rinse between.

Positives and Ferrotypes by Wet Collodion.

BROMO-IODISED COLLODION.

Ether, specific gravity 0.725 ..	10 ozs. (fl.)	1,000 c.c.s.
Alcohol, specific gravity 0.805 ..	5 ozs. (fl.)	500 c.c.s.
Pyroxyline	100 grs.	23 gms.
Cadmium iodide	50 grs.	11 $\frac{1}{2}$ gms.
Ammonium bromide	25 grs.	5.7 gms.
Alcohol, 0.830	5 ozs. (fl.)	500 c.c.s.

Note.—The iodides should be dissolved in the weaker spirit, and the pyroxyline in the ether and stronger spirit, and the two solutions mixed.

SILVER BATH.

Silver nitrate (recryst.)	5 $\frac{1}{2}$ ozs.	70 gms.
Distilled water	80 ozs. (fl.)	1,000 c.c.s.
Nitric acid (pure)	$\frac{1}{2}$ dr.	0.8 c.c.

Saturate with iodide of silver and filter as above.

DEVELOPERS.

Ferrous sulphate	150 grs.	34 gms.
Glacial acetic acid	$\frac{1}{2}$ oz.	50 c.c.s.
Nitric acid	minims	1 c.c.
Alcohol	$\frac{1}{2}$ oz.	50 c.c.s.
Water		1,000 c.c.s.

Note.—By increasing the proportion of nitric acid and decreasing that of the acetic, the image will be more metallic in appearance.

NITRATE OF IRON DEVELOPER.

Ferrous sulphate	1 $\frac{1}{2}$ oz.	75 gms.
Barium nitrate	1 oz.	50 gms.
Water	20 ozs.	1,000 c.c.s.
Alcohol	1 oz.	50 c.c.s.
Nitric acid	40 drops	4 c.c.s.

The insoluble barium sulphate which is formed must be filtered out

FIXING SOLUTION.

Potassium cyanide	$\frac{1}{2}$ oz.	25.30 gms.
Water	15-20 ozs.	1,000 c.c.s.

DEVELOPER FOR COLLODION TRANSFERS.

Pyrogallie acid	4 grs.	9 gms.
Citric acid ..	3 grs.	7 gms.
Acetic acid ..	20 minims	41 c.c.s.
Water ..	1 oz.	1,000 c.c.s.
Alcohol ..	20 minims	41 c.c.s.

Wet Collodion for Half-Tone.

For Winter.

A.—Pyroxyline (tough)	.. ..	190 grs.	21 gms.
Ether (0.720)	.. ..	12 ozs.	600 c.c.s.
Alcohol (0.805)	.. ..	8 ozs.	400 c.c.s.

For Summer.

B.—Pyroxyline (tough)	.. ..	190 grs.	21 gms.
Ether (0.720)	.. ..	10 ozs.	500 c.c.s.
Alcohol (0.805)	.. ..	10 ozs.	500 c.c.s.

IODIZER.

Cadmium iodide ..	.. ..	600 grs.	68 gms.
Ammonium iodide ..	.. ..	210 grs.	24 gms.
Sodium iodide ..	.. ..	210 grs.	24 gms.
Cadmium bromide ..	.. ..	210 grs.	24 gms.
Alcohol ..	.. ..	20 ozs.	1,000 c.c.s.

Use: Iodizer, 1 part; collodion, 15 parts; and set the mixture aside for at least 4 days to ripen. It should then be a bright yellow; if not, add to each ounce 1 minim of a solution of:—Iodine, 16 grs.; alcohol, 1 oz.

Collodion Emulsion.

PYROXYLINE FOR COLLODIO-BROMIDE OR UNWASHED EMULSION.

Nitric acid, specific gravity 1.45	2 ozs. (fl.)	265 c.c.s.
Sulphuric acid, specific gravity 1.845	.. ..	4 ozs.
Water ..	.. ..	1 oz. (fl.)
Cotton (cleaned and carded)	.. ..	100 grs.
		33 gms.

Temperature, 150 degrees F. (65 degrees C.). Time of immersion 10 minutes.

WASHED EMULSION.

Nitric acid, specific gravity 1.45	2 ozs. (fl.)	400 c.c.s.
Sulphuric acid, specific gravity 1.845	.. ..	3 ozs.
White blotting-paper	.. ..	145 grs.
		66 gms.

Temperature, 100 degrees F. (38 degrees C.). Time of immersion 30 minutes.

COLLODIO-BROMIDE EMULSION.

Ether, specific gravity 0.720	.. ..	5 ozs. (fl.)	620 c.c.s.
Alcohol, specific gravity 0.820	.. ..	3 ozs.	380 c.c.s.
Pyroxyline	50 grs.	14.3 gms.
Cadmium ammonium bromide	80 grs.	23 gms.

or

Zinc bromide	76 grs.	21.5 gms.
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Sensitise by adding to each ounce 15 grs. of nitrate of silver dissolved in a few drops of water and 1 drachm of boiling alcohol. This is suitable for slow landscape work or for transparencies.

WASHED EMULSION (for Transparencies).

Ether, specific gravity 0.720 ..	5 ozs. (fl.)	620 c.c.s.
Alcohol specific gravity 0.820 ..	3 ozs.	380 c.c.s.
Pyroxyline or papyroxyline ..	60 grs.	17 gms.
Cadmium ammonium bromide ..	100 grs.	29 gms.
or		
Zinc bromide	96 grs.	27.5 gms.
Hydrochloric acid (specific gravity 1.2)	8 minims	2 c.c.s.

Sensitise with 20 grs. of silver nitrate to each ounce (4.3 gms. to each 100 c.c.s.), dissolved in a minimum of water with 2 drachms (13 c.c.s.) of boiling alcohol. Allow to stand for two or three days.

N.B.—In the last formula the emulsion, after being allowed to ripen for the time stated, should be poured into a dish and allowed to become thoroughly dry. The mass of dry emulsion is then washed to remove all the soluble salts, and is then again dried and redissolved in equal parts of ether and alcohol, at the rate of from 20 to 24 grs. to the ounce of solvents.

Stripping Wet Collodion Negatives.

When the negative is thoroughly dry and cool, flow over with thin solution of rubber in benzole, 2 parts pure rubber to 100 parts benzole, or ordinary cycle tyre repairing solution thinned down to about the consistency of collodion will do. When this is dry, the negative is flowed over with "leather" collodion. This is prepared by adding a small quantity of castor oil to plain collodion. A good formula is as follows:—

Pyroxyline (tough)	½ oz.	2 gms.
Ether	5 ozs.	50 c.c.s.
Alcohol	5 ozs.	50 c.c.s.
Castor oil	½ oz.	2 c.c.s.

When the collodion on the negative is dry (and the drying can be hastened by heat) the negative is cut round the edges with a knife and placed in a dish of cold water. The film should soon begin to loosen at the edges; if it does not a little acetic acid (up to 10 per cent.) may be added to the water. The film is now transferred to a piece of paper, and thence to the new support. If the negative is to be reversed it is transferred to another piece of paper before being placed on its final support.

Pyroxyline, for leather collodion and the wet-collodion process, replacing certain German products, will, it is hoped, be made before long by the New Explosives Co., Ltd., 62, London Wall, London, E.C.

PLAIN AND ALBUMEN PAPERS.

Plain Paper.

The following are formulæ for "salting" and sensitizing papers such as Whatman's drawing papers, etc.

First prepare the plain paper with—

Ammonium chloride	.. ..	60-80 grs.	14-18 gms.
Sodium citrate	.. ..	100 grs.	23 gms.
Sodium chloride	.. ..	20-30 grs.	4.5-7 gms.
Gelatine	.. ..	10 grs.	2 gms.
Distilled water	.. ..	10 ozs.	1,000 c.c.s.

or—

Ammonium chloride	100 grs.	23 gms.
Gelatine	10 grs.	2 gms.
Water	10 ozs.	1,000 c.c.s.

The gelatine is first swelled in cold water and then dissolved in hot water, and the remaining components of the formula are added. The solution is filtered, and, when still warm, the paper floated upon it for three minutes and dried.

The salted paper is sensitized upon a neutral 45-grain silver bath.

PLATINUM TONING BATH.

Potass. chloroplatinite	.. ..	4½ grs.	1 gm.
Water	.. ..	10 ozs.	1,000 c.c.s.
Nitric acid	.. ..	2-3 drops.	5-10 drops.

Albumen Paper.

The albumenized paper, as purchased, is sensitized on the following silver solution:—

Silver nitrate	.. ..	600 grs.	140 gms.
Distilled water	.. ..	10 ozs.	1,000 c.c.s.

The bath is made just acid with nitric acid, requiring three or four drops per 10 ozs.

TONING BATHS.

No. 1.—Gold chloride	.. ..	1 gr.	0.3 gm.
Sodium acetate	.. ..	30 grs.	6 gms.
Water	.. ..	8 ozs.	1,000 c.c.s.

This must not be used till one day after preparation. It keeps well and gives warm, rich tones.

No. 2.—Gold chloride	.. ..	15 grs.	1 gm.
Water	.. ..	4 ozs.	120 c.c.s.

Add lime water until a piece of red litmus paper, placed in the solution, is turned blue. Then add—

Calcium chloride, fused	.. ..	120 grs.	7.7 gms.
Water to make	.. ..	7½ ozs.	115 c.c.s.

This solution is diluted with 15 times its volume of water to make the toning bath; it can be used over and over again by addition of stock solution.

PRESERVATIVE FOR SENSITIZED ALBUMEN PAPER.

Sensitize the paper in the usual bath, drain well, and when superficially dry float the back of the paper for twenty minutes on a solution of—

Citric acid	..	..	..	1 oz.	33 gms.
Water	..	..	..	30 ozs.	1,000 c.c.s.

TO PREVENT BLISTERS IN ALBUMEN PRINTS.

Before wetting the prints immerse them in methylated spirit, then wash and tone as usual.

GELATINE P.O.P.

Emulsion Formulæ.

BARKER'S.

Gelatine (Nelson's No. 1 and

Coignet's, equal parts)	..	175 grs.	80 gms.
Ammonium chloride	..	18 grs.	8 gms.
Rochelle salts	..	50 grs.	23 gms.
Silver nitrate	..	75 grs.	34 gms.
Alcohol	..	4 drs.	160 c.c.s.
Water	..	5 ozs.	1,000 c.c.s.

Heat to 100 degrees F. (38 degrees C.), and allow to remain at this temperature after all is dissolved for ten minutes, after which proceed in the usual way.

VALENTA'S.

A.—Silver nitrate	..	..	480 grs.	32 gms.
Citric acid	..	..	120 grs.	8 gms.
Hot water	..	..	5½ ozs.	160 c.c.s.
B.—Gelatine	..	..	1,440 grs.	96 gms.
Ammonium chloride	..	..	42 grs.	2.8 gms.
Water	..	..	24.3 ozs.	700 gms.
C.—Tartaric acid	..	..	42 grs.	2.8 gms.
Sodium bicarbonate	..	..	21 grs.	1.4 gm.
Alum	..	..	27 grs.	1.8 gm.
Water	..	..	5 ozs.	140 c.c.s.

Allow the gelatine to swell in the water and melt by the aid of heat, and add the chloride. Mix B and C at 50 degrees C., and in yellow light add A, heated to the same temperature, in small quantities, shaking thoroughly, and allow the emulsion to ripen for a short time at from 40 degrees to 50 degrees C. and then filter. For matt surface papers the gelatine should be reduced to 750 grs. or 80 gms.

The above formula gives vigorous brilliant prints, but for soft negatives a harder printing emulsion is obtained by adding from 0.05 to 0.1 per cent. of calcium bichromate solution; this can be made by dissolving 480 grs. or 25 grms. of pure chromic acid in 4 ozs. or 100 c.c.s. of distilled water, and adding sufficient pure chalk (calcium carbonate) to make the solution cloudy. The solution should then be filtered, and the filter washed with distilled water up to 4 ozs. or 100 c.c.s.

BEADLE'S.

Nelson's gelatine	340 grs.	112 grms.
Alum	15.5 grs.	5 grms.
Water	6 1/2 ozs.	900 c.c.s.
Rochelle salts	15.5 grs.	3.5 grms.
Ammonium chloride	11 grs.	5 grms.

Heat to 50 degrees C., and add—

Silver nitrate	115 grs.	37.5 grms.
Citric acid	62 grs.	20 grms.
Water	1 oz.	100 c.c.s.

Procedure in P.O.P. Printing.

Wash prints in several changes of water until wash water ceases to show milkiness when poured into clean glass measure (time, 10 to 15 minutes). Tone in gold bath (5 to 10 minutes). Again wash as thoroughly as before toning. Fix in:—hypo, 2 to 3 ozs.; water, 20 ozs., for 10 minutes. Finally wash in running water or frequent changes (every 5 or 10 minutes) for 1 to 2 hours.

Prints can be toned in a platinum bath instead of in one of gold (see formulæ below). The other manipulations remain the same as above. The tones are best suited to matt surface paper.

Prints can be toned and fixed at the same time in a "combined" bath (see formulæ below). With some baths and papers it is best to wash before toning; with others it is not necessary. The tones by the "combined" method are almost always warmer than by separate toning and fixing. Also they are somewhat inferior in permanence.

P.O.P. prints may be printed faintly and then developed up to full strength (see "Developing P.O.P." below). The colour of the developed prints is usually not pleasing, and it is necessary to tone. This is done as a rule in a combined bath. P.O.P. to be developed must not be exposed to strong light before printing, when loading frames or examining prints. It must be handled as though it were "gaslight" paper.

Gold Toning Baths.

SULPHOCYANIDE.

This is the best and most generally used toning bath for P.O.P. and yields fine purplish tones.

Gold chloride	2 1/2 grs.	0.3 gm.
Ammonium sulphocyanide	30 grs.	3.5 grms.
Water	20 ozs.	1,000 c.c.s.

It is necessary for this and all sulphocyanide baths to ripen. The best method of mixing is to boil the water and to dissolve the gold in one half and the sulphocyanide in the other—both scalding hot. Then pour the gold into the sulphocyanide in small doses, stirring all the time; use when cool. If cold water is used, the mixture should be allowed to stand 12 hours.

CONCENTRATED SULPHOCYANIDE.
(*Bühler's Formula.*)

A.—Distilled water	..	..	1 cz.	150 c.c.s.
Gold chloride	..	..	15 grs.	5 gms.
B.—Strontium chloride	..	..	150 grs.	50 gms.
Distilled water	..	..	$\frac{3}{4}$ oz.	100 c.c.s.
C.—Potassium sulphocyanide	..	..	80–150 grs.	25–50 gms.
Distilled water	..	..	$1\frac{3}{4}$ oz.	250 c.c.s.

Heat B to boiling, and add A (heated to 150 degrees F.) in small doses. Bring C to boiling, and allow to cool to 205 degrees F., and add the hot mixture of A and B in four or five lots with constant stirring; cool and filter. If a precipitate forms, reheat to nearly boiling, wash the filter with $\frac{3}{4}$ oz. (100 c.c.s.) water, and add this latter to the total bulk. The bath is diluted with 10 times its volume of water for use.

FORMATE.

Gold chloride	..	..	1 gr.	0.12 gm.
Sodium bicarbonate	..	..	2 grs.	0.23 gm.
Sodium formate	..	..	8 grs.	0.9 gm.
Water	..	..	20 ozs.	1,000 c.c.s.

The prints should be immersed in a 10 % solution of salt and water before using this bath.

TUNGSTATE.

Sodium tungstate	..	..	30 grs.	3.5 gms.
Sodium carbonate	..	..	1 gr.	0.12 gm.
Gold chloride	..	..	1 gr.	0.12 gm.
Water	..	..	10–20 ozs.	500–1,000 c.c.s.

An excellent bath for warm brown tones:

THIOCARBAMIDE.

Gold chloride	..	..	4 grs.	0.25 gm.
Distilled water	..	..	1 oz.	25 c.c.s.

Add, to dissolve precipitate first formed, sufficient of—

Thiocarbamide	..	..	90 grs.	1 gm.
Distilled water	10 ozs.	50 c.c.s.

About $\frac{3}{4}$ oz. (14 to 15 c.c.s.) will be needed. Next add—

Citric acid	8 grs.	0.5 gm.
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and

Distilled water to	35 ozs.	1,000 c.c.s.
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and finally

Salt	160 grs.	10 gms.
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The prints should be thoroughly washed *before* as well as *after* fixing.

SHORT STOP FOR GOLD TONING.

A weak solution of sodium sulphite (5 grs. per oz.) at once arrests the action of a gold toning bath.

SALT BATH.

A short immersion of prints in the following bath prior to the first washing favours even toning and prevents spots and stains from rusty tap water:—

Salt	.. ..	2 ozs.	100 grs.
Sodium carbonate	.. ..	1 oz.	50 grs.
Water	.. ..	20 ozs.	1,000 c.c.s.

If prints are to be toned in the platinum bath the carbonate should be omitted.

Platinum Toning Baths.**PHOSPHORIC ACID.**

Potass. chloroplatinite	.. ..	4 grs.	0.45 gm.
Phosphoric acid (sp. gr. 1.12)	.. ..	$\frac{3}{4}$ oz. (fl.)	35 c.c.s.
Water to	.. ..	20 ozs.	1,000 c.c.s.

CITRIC ACID.

Potass. chloroplatinite	.. ..	4 grs.	0.45 gm.
Sodium chloride (salt)	.. ..	40 grs.	4.5 grs.
Citric acid	.. ..	50 grs.	5.8 grs.
Water to	.. ..	20 ozs.	1,000 c.c.s.

HADDON'S FORMULA.

Platinum perchloride	.. ..	3 grs.	0.2 gm.
Sodium formate	.. ..	100 grs.	6.5 grs.
Formic acid	.. ..	30 minims	1.8 c.c.
Water to	.. ..	35 ozs.	1,000 c.c.s.

SHORT STOP FOR PLATINUM TONING.

A weak solution of sodium carbonate (10 grs. per oz.) instantly arrests the toning action of a platinum bath.

Combined Baths.**VALENTA'S.**

Hypo	.. ..	8 ozs.	400 grs.
Ammonium sulphocyanide	.. ..	1 oz.	50 grs.
Lead nitrate	.. ..	175 grs.	20 grs.
Alum	.. ..	350 grs.	40 grs.
Water to	.. ..	20 ozs.	1,000 c.c.s.

Dissolve the hypo in the water, add the sulphocyanide, then add the alum dissolved in a little water, and also the lead, and add to the hypo. Heat the mixture to 120 deg. F. for ten minutes; allow to cool. For use take—

Stock solution (as above)	.. ..	10 ozs.	100 c.c.s.
Water	.. ..	10 ozs.	100 c.c.s.
Gold chloride (from stock sol.)	.. ..	$\frac{3}{4}$ grs.	0.23 gm.

ALKALINE TONING AND FIXING BATH.

Gold chloride	..	..	..	2 grs.	0.23 gm.
Lead nitrate	..	..	..	10 grs.	1.2 gm.
Chalk	..	..	..	$\frac{1}{2}$ oz.	25 gms.
Hypo	..	..	..	4 ozs.	200 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Shake the solution well, allow to settle, and use the clear portion. If prints tone too quickly, under 10 minutes, in the combined bath, it is best to pass them afterwards through a plain fixing bath.

Reducer for Over-Printed Proofs.

- A.—Ammonium sulphocyanide 10% sol.
 B.—Potass. ferricyanide 10% sol.
 A, 5 ozs.; B, $\frac{1}{2}$ oz.; water, 24 ozs.

This is used on the prints after toning, fixing and well washing out the hypo in the usual way.

Developing P.O.P.

DIRECT PROCESS WITH ACID DEVELOPER.

Hydroquinone	..	..	..	16 grs.	18.5 gms.
Citric acid	..	..	..	40 grs.	4.6 gms.
Sodium acetate	..	..	..	1 oz.	50 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Immerse the dry prints in the developer, and, after development, wash in plenty of water for ten or fifteen minutes, then tone in the usual way.

Pyro (Blacklock).

A.—Pyro	..	..	..	40 grs.	4.6 gms.
Tartaric acid	..	..	..	40 grs.	4.6 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Will keep three or four weeks.

B.—Potass. bichromate	..	..	..	$\frac{1}{2}$ gr.	0.06 gm.
Water	..	..	..	16 ozs.	1,000 c.c.s.

B is best made up from a stock solution of 1 gr. per ounce, adding $\frac{1}{2}$ dr. of it to 16 ozs. of water. To develop, mix equal parts of A and B.

Six or seven inches of magnesium ribbon burnt close to the frame will suffice for the exposure.

The fixing bath is:—

Hypo	..	..	..	3 $\frac{1}{2}$ ozs.	160 gms.
Lead acetate	..	..	..	200 grs.	23 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

in which the prints lose very little.

PAGET "BROMIDE" PROCESS.

The prints are immersed in 10 per cent. potass. bromide solution for five or ten minutes, washed and developed with the following:—

A.—Hydroquinone	..	..	..	40 grs.	4.5 gms.
Sodium sulphite	..	..	..	160 grs.	18 gms.
Water to	..	..	..	20 ozs.	1,000 c.c.s.

B.—Potass. bromide	2½ ozs.	125 gms.
Sodium carbonate	2 ozs.	100 gms.
Water to	20 ozs.	1,000 c.c.s.
C.—Potass. cyanide	½ oz.	25 gms.
Water	20 ozs.	1,000 c.c.s.

For average negatives, mix:—A, ½ oz.; B, 1 oz.; C, 20 minims; water, ½ oz.

For flat negatives (greater contrast), A, 3 drs.; B, 1 oz.; water, 5 drs.

For hard negatives (soft results), A, 7 drs.; B, 1 oz.; water, 1 dr.

The cyanide solution is used as above in quantity sufficient to keep the backs of prints clean.

Glazing P.O.P.

POLISH FOR SQUEEGEEING GLASSES.

* A polishing medium to be applied to glass or ferrotype before squeegeeing the print is—

Beeswax	20 grs.	45 gms.
Turpentine	1 oz.	1,000 c.c.s.
or		
Spermaceti wax	20 grs.	45 gms.
Benzole	1 oz.	1,000 c.c.s.

a few drops of which are rubbed on with a piece of flannel, and the glass afterwards polished with silk rag or chamois leather.

ENAMEL COLLODION.

Soluble gun cotton	50 grs.	14 gms.
Alcohol	4 ozs.	500 c.c.s.
Sulphuric ether	4 ozs.	500 c.c.s.

Glass plates cleaned with French chalk are coated with the above, and, as soon as coating has set, slipped under prints which are waiting face down in water. Prints are withdrawn and squeegeed. When half dry they are given a backing paper and finally stripped off. (For both gelatin and collodion prints.)

COLLODIO=CHLORIDE P.O.P.

Emulsion Formula.

(Valenta.)

1.—Strontium chloride	154 grs.	10 gms.
Lithium chloride	77 grs.	5 gms.
Water	500 minims	30 c.c.s.
Alcohol (absolute)	930 minims	55 c.c.s.
2.—Silver nitrate	400 grs.	20 gms.
Water	500 minims	30 c.c.s.
Alcohol	1,000 minims	60 c.c.s.
3.—Citric acid	77 grs.	5 gms.
Alcohol	645 minims	40 c.c.s.
Glycerine	92 grs.	6 gms.

In a bottle capable of holding 1,000 parts pour 350 parts of 3 per cent. collodion and add gradually 15 parts of No. 1. Then in the dark room add almost drop by drop 60 parts of No. 2, shaking well after each addition; then add 50 parts of No. 3 and 50 parts of ether. This collodion is suitable for normal negatives, but more contrast can be obtained if 0.1 to 0.4 per cent. calcium chromate solution is added. By reducing the amount of pyroxyline in the above formula the emulsion is more suitable for matt surface paper. (See "Gelatine P.O.P.")

Procedure in C.C. Printing.

Prints are washed in changes of water until latter is free from milkiness, and then toned either with gold or platinum; but most usually and for the best warm black tones, first in gold and then (after washing) in platinum. They are then again well washed and fixed like gelatine P.O.P. prints. C.C. prints as a rule do not yield the best results in the combined bath. C.C. papers are not suitable for the "development" process described under Gelatine P.O.P.

Gold-Platinum Toning.

For Black Tones.

The following is the usual practice in toning collodion prints:—

Wash in several changes, and tone the shadows to a brown (when seen by transmitted light) in the following:—

Borax	..	..	..	90 grs.	10 gms.
Gold chloride	..	..	..	2 grs.	0.2 gm.
Water	..	..	..	20 ozs.	1,000 c.c.s.

This bath is ready within a few minutes of mixing. It is conveniently made just before washing the prints. The quantity of borax is adjusted to the working. If the lighter tones disappear, add more borax; if the prints lack brilliance, add gold. After a ten-minute wash, transfer to the platinum bath, which may be strong or weak, the only difference being that a larger number of prints may be treated together in the weaker bath.

Stock solution:—

Potass. chloroplatinite	..	..	30 grs.	7 gms.
Phosphoric acid (specific gravity 1.12)	..	..	5 drs.	30 c.c.s.
Water to make	..	..	20 ozs.	1,000 c.c.s.

This may be made up to 60 ozs. at once, or added little by little to water, as the prints are passed through a few at a time.

The prints are next washed in about eight changes of water (to the fifth or so of which it is well to add a little bicarbonate of soda to neutralise traces of acid) before fixing.

Gold Toning Baths.

BORAX-ACETATE.

Borax	..	..	..	90 grs.	10 gms.
Sodium acetate	..	..	..	90 grs.	10 gms.
Gold chloride	..	..	..	2½ grs.	0.3 gm.
Water	..	..	..	20 ozs.	1,000 c.c.s.

SULPHOCYANIDE.

Ammonium sulphocyanide	..	90 grs.	10 gms.
Gold chloride	.. ..	2½ grs.	0.3 gm.
Water	.. ..	20 ozs.	1,000 c.c.s.

For bluish-black tones.

SULPHOCYANIDE-ACETATE.

Ammonium sulphocyanide	..	35 grs.	4 gms.
Sodium acetate	.. ..	3 oz.	45 gms.
Gold chloride	.. ..	5 grs.	0.6 gm.
Water	.. ..	20 ozs.	1,000 c.c.s.

Is made up one hour before using, preferably from stock solutions of the substances. With sodium tungstate, instead of the acetate, gives fine chestnut tones.

The maker's formulæ should be studied in connection with the above baths as papers differ considerably in the quantity of gold required in the toning solution.

Platinum Toning Baths.

The phosphate formula given above under "Gold Platinum Toning" is suitable for the production of the warm brown and sepia tones, which are given by the platinum baths alone. Others are:—

Citric acid	.. ..	45 grs.	5 gms.
Potass. chloroplatinite	.. ..	4 grs.	0.5 gm.
Water	.. ..	20 ozs.	1,000 c.c.s.

Lactic acid (specific gravity 1.21)	25 grs.	3 gms.
Potass. chloroplatinite	4 grs.	0.5 gm.
Water	20 ozs.	1,000 c.c.s.

SALT-BICARBONATE BATH.

The following is used between washing and toning with the platinum bath as a means of removing free silver, and bringing the prints into a state of regular neutrality:—

Salt	.. ..	½ oz.	25 gms.
Sodium bicarbonate	.. ..	45 grs.	5 gms.
Water	.. ..	20 ozs.	1,000 c.c.s.

Toning Baths for Various Warm Tones.*For Warm Sepia Tones.*

The prints are washed in three changes of warm water and placed in:—

Ammonia	.. ..	1 dr.	6 c.c.s.
Warm water	.. ..	20 ozs.	1,000 c.c.s.

until they become lemon yellow. They are then again washed in three changes of water and toned for about one minute in the gold borax bath above.

For Red Chalk Tones.

The prints are washed in a couple of changes of water and placed for about half an hour (until they become orange-yellow) in :—

Salt..	..	..	..	1 oz.	50 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

After which they are washed for about one minute and toned, for a few seconds only, in the *barytes* bath above.

For Violet Tones.

Print deeply from the negatives and tone until the colour desired is reached in :—

Hydrochloric acid	..	..	6 ozs.	300 c.c.s.
Gold chloride	..	..	10 grs.	1·2 gm.
Water to make	..	..	20 ozs.	1,000 c.c.s.

After which wash thoroughly and fix in 5 per cent. hypo. Less acid in the above bath tends to bluish-violet, more to violet purple.

Combined Baths.

Collodion papers, although not generally suitable for use with the combined bath, may in some cases be toned in it. The Valenta formula (see "Gelatine P.O.P." above) is suitable, also the following (Kurz) :—

Water	..	..	..	20 ozs.	1,000 c.c.s.
Hypo	..	..	..	5 ozs.	250 gms.
Ammonium sulphocyanide	..	..	..	240 grs.	28 gms.
Alum	..	..	..	70 grs.	7·5 gms.
Citric acid	..	..	..	70 grs.	7·5 gms.
Lead nitrate	..	..	..	90 grs.	10 gms.
Lead acetate	..	..	..	90 grs.	10 gms.
Gold chloride	..	..	..	3½ grs.	0·4 gm.

It is turbid when first made, but clears after a few days.

BROMIDE AND GASLIGHT PAPERS.

Procedure.—Bromide paper must be handled in yellow or orange light; gaslight can be worked in weak day or artificial light. Bromide papers develop in from two to five minutes, whilst many (but not all) gaslight papers develop in a second or two. Apart from these distinctions the general working of the two classes of paper is the same, viz., exposure which has no visible effect on the paper; development; a brief rinse; fixing in :—hypo, 3 to 4 ozs.; water 20 ozs.;

and thorough washing in running water or frequent changes, say for one hour.

The following developers are a few only of the standard. The makers' formulae should be consulted.

Amidol.

Sodium sulphite	62 grs.	74 gms.
Potass. bromide	16 grs.	1.2 gm.
Water	20 ozs.	1,000 c.c.s.

When dissolved add—

Amidol	50 grs.	5.7 gms.
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This developer will not keep more than three days.

See also the formula given under "Negative Developers."

The most convenient and economical method of using amidol developer for bromide papers is to make up a 10 per cent. stock solution of sodium sulphite, and add 5 grs. potassium bromide to each 10 ozs. solution. For use add 4 grs. dry amidol to each ounce stock solution, and dilute with an equal bulk of water.

Metol.

(See Monomet and Scalol under "Developers and Development.")

Metol-Hydroquinone.

(See Monomet-Hydroquinone and Scalol-Hydroquinone under "Developers and Development.")

Monomet.

The stock solution is that given under "Developers and Development" (negatives) on an earlier page. For gaslight papers it is used as it is; for bromide papers it is mixed with an equal bulk of water.

Monomet-Hydroquinone.

The stock solution is that given under "Developers and Development" (negatives). For gaslight papers this is used as it is; for bromide papers it is mixed with an equal bulk of water.

Scalol.

The stock solution is that given under "Developers and Development" (negatives) and is used as there directed.

Scalol-Hydroquinone.

The stock solution is that given under "Developers and Development" (negatives), and is used as there directed.

Ferrous Oxalate.

A.—Sulphate of iron	5 ozs.	250 gms.
Sulphuric acid	30 minims	3 c.c.s.
Warm water to	20 ozs.	1,000 c.c.s.

B.—Potass. oxalate (neutral)	5 ozs.	250 gms.
Potass. bromide	10 grs.	1.2 gm.
Warm water to	20 ozs.	1,000 c.c.s.

For use add 1 oz. of A to 4 ozs. of B, not *vice versa*.

After development and without washing, immerse the prints for two minutes in acid bath, pour off and repeat.

ACID BATH.		
Glacial acetic acid	1 dr.	6 c.c.s.
Water	20 ozs.	1,000 c.c.s.

Then wash thoroughly to remove last trace of acid.

Clearing Bath.

To remove yellow stain from bromide prints, the following is suitable:—

Alum (saturated solution)	10 ozs.	1,000 c.c.s.
Hydrochloric acid	3 drs.	40 c.c.s.

Reducer for Bromides.

Over-developed prints are best treated in a weak iodine-cyanide reducer made from (A) 10% solution of iodine in potass. iodide and (B) 10% potass. cyanide solution. Take:—

A.	30 minims	2 c.c.s.
B.	10 minims	0.6 c.c.
Water	2 ounces	60 c.c.s.

Adding more of A and B if necessary.

Strong Prints from Flat Negatives.

The prints are fully exposed and over-developed, fixed and washed. They are then placed in the following iodine bath until whites are strongly blue, and then fixed for five minutes.

IODINE BATH.		
Potass. iodide	30 grs.	7 gms.
Iodine	3 grs.	0.7 gm.
Water	10 ozs.	1,000 c.c.s.

If not sufficiently lightened, the print may be washed and the process with bleaching bath and hypo repeated.

Stress Marks on Bromides.

Avoid rubbing paper against other sheets in boxes or packets, and against negative or mask. In cutting up large sheets, use shears on open sheet, not knife, etc., which rubs on emulsion surface. Have developer water-clear, free from sediment and any floating dirt. Use plenty of developer.

Addition of from 40 to 60 minims of 10 per cent. solution of potass. cyanide to each 10 ozs. of developer will avoid stress marks in many cases, or a developer may be made up as follows:—

Soda sulphite	1 oz.	50 gms.
Water	20 ozs.	1,000 c.c.s.
Potass. bromide	2 grs.	0.23 gm.
Amidol	35 grs.	4.0 gms.
Potass. cyanide	2 grs.	0.23 gm.

If stress marks occur, they can usually be removed by gently rubbing each print with a soft rag as soon as it has had a minute or so in the wash-water. A further aid to removal is a solution of borax, $\frac{1}{2}$ oz.; water, 20 ozs.; methylated spirit, 5 ozs., rubbed over with soft rag or cotton wool.

Hypo-Alum Toning.

The following is a method (much used on the commercial scale) for toning bromide prints to a warm purplish sepia:—

Hot water	20 ozs.	1,000 c.c.s.
Hypo	2½ ozs.	125 gms.

Dissolve and add—

Alum	½ oz.	25 gms.
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This mixture should not be filtered, and it works better as it becomes older; it may be strengthened from time to time with a little fresh solution.

The best results are obtained by keeping the bath hot, or as warm as the emulsion will stand, say 100 to 120 degrees F. In this bath prints will tone in 30 to 40 minutes. When this toning bath is to be employed, the use of the alum bath after fixing is absolutely essential. Moreover, the prints should not, in this case, be subjected to a prolonged washing, but should only be slightly rinsed before being dried.

A new bath tends to reduce the prints rather more than an old one.

When toned the prints should be placed in a tepid solution of—

Water	70 ozs.	1,000 c.c.s.
Alum	2 ozs.	30 gms.

and then washed thoroughly.

Sulphide Toning.

Of the many methods of producing sepia to warm brown tones on bromide or gaslight the following is the best and most reliable. Prints require to be well washed from hypo before being put into the bleacher. In summer, or in places where the water supply has a softening action on prints, it is well to fix them in a fixing hardening bath. (See "Fixing.")

BLEACHER.

Ammonium bromide	100 grs.	11 gms.
Potass. ferricyanide	300 grs.	35 gms.
Water	20 ozs.	1,000 c.c.s.

SULPHIDE BATH.

It is best to keep the sulphide in strong, 20 per cent., solution; a weak solution does not keep well. Use the pure *white* sulphide, dissolving 4 ozs. in water and making up to 20 ozs.

To make the working sulphide bath, mix:—

Stock 20% sulphide solution	3 ozs.
Water to make	20 ozs.

The prints are treated for two or three minutes in the bleacher—that is, until the picture becomes faint brown in colour. If any black is left at the end of two minutes it is a sign that the bleacher (which may be used repeatedly) is becoming exhausted.

Rinse in clean water for half-a-minute to one minute. Longer washing at this stage does no good and may lead to impaired tone.

Transfer to sulphide bath, where prints should darken to the full brown or sepia in a second or two.

Throw away the sulphide bath after the day's use. Stale spent sulphide solution is the most frequent cause of bad tones or of refusal of prints to darken in the sulphide bath.

Finally wash for half-an-hour in running water.

The results by the sulphide process are quite permanent.

Blue stains in spots and patches, on sulphide-toned prints, are due to iron, either as rust in the tap-water, or as impurity in alum. Fit a flannel filter to the tap and use pure alum. Wiping with cotton-wool saturated with strong hydrochloric acid will slowly change the stain to yellow which washes out in water. But it is a rather risky remedy.

Sulphide-toned prints of bad colour or insufficient depth can be re-treated, e.g., by bleaching in:—copper bromide, 130 grs.; sodium bromide, 2½ ozs.; water, 10 ozs. This is used in the dark-room, the bleached print taken into daylight and re-developed with amidol or other clean developer, after which it may be retoned.

Permanganate Bleach Process.

(T. H. Greenall's formula.)

This process allows of prints being toned after a very brief rinse from the fixing bath; also it requires no washing (or only the briefest) between bleaching and sulphiding.

BLEACHER.

A.—Hydrochloric acid B.P. 31.8%	3 ozs.	150 c.c.s.
Water to make	20 ozs.	1,000 c.c.s.
B.—Potass. permanganate	40 grs.	4.5 gms.
Water	20 ozs.	1,000 c.c.s.

Both A and B keep indefinitely when well stoppered.

To make the bleacher, mix in order given:—Water, 6 ozs.; A, 1 oz.; B, 1 oz. Cost of working mixture is about ¾d. per 20 ozs. If prints do not bleach completely, throw bleacher away and mix fresh. Any brown stain disappears in the sulphide bath, which should be of strength 1 gr. per oz. made up from strong solution.

If, by using more of A or B than directed above, there is any brown stain on sulphided prints, a bath of oxalic acid, ½ oz.; water, 50 ozs., with a few crystals of soda sulphite dissolved in it, will at once remove them.

Copper Toning.

This process yields a range of tones from warm black to red chalk, the warmth of tone increasing as the solution acts on the print. The process does not intensify the prints; it is cheap and the results are permanent.

A.—Copper sulphate	60 grs.	7 gms.
Potass. citrate (neutral)	240 grs.	28 gms.
Water	20 ozs.	1,000 c.c.s.
B.—Potass. ferricyanide	50 grs.	6 gms.
Potass. citrate (neutral)	240 grs.	28 gms.
Water	20 ozs.	1,000 c.c.s.

Use equal parts of each. If prints are pinkish in the high-lights, use more citrate in the A or B solution.

Platinum Toning.

Not for Gaslight Prints.

Potass. chloroplatinite	1½ grs.	0.8 gm.
Mercuric chloride	6 grs.	0.4 gm.
Citric acid	54 grs.	3.4 gms.
Water	6 ozs.	170 c.c.s.

This bath should be made up fresh for use from stock solution. Gives warm sepia tones, with slight staining of high-lights. For cold sepia tones and absence of staining add 30 minims 10 per cent. solution potassium bromide to above. Wash well after toning.

Uranium Toning.

This old method yields brown to reddish tones. It intensifies the prints, and the results often prove impermanent.

A.—Uranium nitrate	90 grs.	10 gms.
Water	20 ozs.	1,000 c.c.s.
B.—Potass. ferricyanide	90 grs.	10 gms.
Water	20 ozs.	1,000 c.c.s.

Use equal parts of A and B, and add 20 minims of glacial acetic acid to each ounce of mixture. The prints must be free from hypo. After toning wash in several changes of still water till the high-lights are clear. Washing in running water will remove the toning in patches. Citric acid (10 grs. per oz.) or oxalic acid (5 grs. per oz.) instead of acetic is an aid to pure whites.

As a means of rendering uranium-toned prints permanent, it is recommended to fix the toned prints for five minutes in hypo, ½ oz.; potass. metabisulphite, 70 grs.; water, 20 ozs.

Green Tones.

(H. E. Smith's formula without scheduled poisons.)

A.—Potass. ferricyanide	180 grs.	2 gms.
Water, distilled	20 ozs.	100 c.c.

B.--Vanadium chloride stock solution	3½ drs.	4 c.c.s.
Ferric ammonium citrate (<i>green</i> scales)	45 grs.	1 gm.
Soda citrate neutral (Merck) ..	2½ ozs.	25 gms.
Ammonium chloride	90 grs.	2 gms.
Hydrochloric acid, strong pure..	1½ ozs.	14 c.c.s.
Water distilled	10 ozs.	100 c.c.s.

The stock vanadium solution is made by mixing 1 oz. of vanadium chloride, as purchased (Merck's syrupy), with 5 drams (12 c.c.s.) of strong hydrochloric acid and then adding distilled water to make 2 ozs. 90 minims (62 c.c.s.) in all.

In making up the B solution, first add the hydrochloric acid to the vanadium solution. Then dissolve the ferric citrate, soda citrate, and ammonium chloride in the 10 ozs. (100 c.c.s.) water and mix the two. Solution should be dull mauve blue; not green—until mixed with A.

Both A and B solutions will keep for months at least.

To mix the toning solution, take 1 part A with 4 parts water; and, separately, 1 part B with 4 parts water. The two weak solutions when mixed together form the toner.

Prints tone in from 4 to 8 minutes. Rock constantly, then wash in 5 changes of water, each of 2 minutes, give a bath of hydrochloric acid (1 part in 50 parts water) for 2 minutes, and finally wash for 15 minutes in 7 or 8 changes of water.

Prints should be of the ordinary depth. The green tone is permanent.

Blue Tones.

citrate	2 ozs.	10 c.c.s.
10% solution potassium ferri-		
cyanide	2 ozs.	10 c.c.s.
10% solution acetic acid..	20 ozs.	100 c.c.s.

The well-washed prints are immersed in this bath until the desired tone is given. Then well wash until high-lights are clear. This bath intensifies the image.

Gold Toning.

This process considerably improves the colour of greenish or rusty black prints, and if allowed to act for some time bluish tones are obtained.

Ammonium sulphocyanide ..	30 grs.	2 gms.
Chloride of gold	2 grs.	0.13 gm.
Boiling water	4 ozs.	110 c.c.s.

Use as soon as cool. Place the wet print face upwards on a sheet of glass, squeegee into contact, blot off superfluous moisture, and paint the above bath on with a broad flat brush; when the desired tone is reached wash well and dry.

Practically all the above toning solutions can be employed for lantern plates.

Line Drawings from Bromide, Gaslight, or P.O.P. Prints.

After outlining the subject in waterproof Indian ink, bleach out the image in—

Thiocarbamide	..	..	..	240 grs.	25 gms.
Nitric acid	..	..	..	4 drs. (fl.)	25 c.c.s.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Or in—

Iodine sol. (10 per cent. in potass.	..	..	..	30 minims	6 c.c.s.
iodide sol.)	..	..	..
Potass. cyanide (10 per cent. sol.	..	..	..	5 minims	1 c.c.
in water)	..	..	..
Water	..	..	..	1 oz.	100 c.c.s.

THE CARBON PROCESS.

Procedure.—Tissue, *i.e.*, paper coated with a mixture of gelatine and pigment colour, is made sensitive by immersion in bichromate solution, dried, and printed under the negative by daylight. As the colour of the tissue hides the effect of light, the printing is done by aid of an actinometer.

The effect of the light is to render the gelatine insoluble—deeper down into the tissue, the greater the action. “Development” consists in dissolving out in warm water the tissue which remains soluble. As a skin of insoluble tissue is formed over the whole top surface of the print, the coating is first transferred (face down) on to a fresh support. To do this, the exposed tissue is soaked in cold water along with a sheet of (gelatine-coated) transfer paper, the two squeezed together, put under pressure for about 20 minutes, and then placed in hot water. The original support of the sensitive surface is stripped off, leaving the tissue with its face (the insoluble side) on the transfer paper. The soluble gelatine can be then dissolved away (development), carrying the pigment with it, and the prints are finally passed through an alum bath, washed and dried. As this transference of the print to a new support causes the picture to appear reversed as regards right and left, it is necessary (where this is an objection) to transfer first on to a “temporary support” for development, and from this again on to the “final support.”

Sensitising Solutions.

Potass. bichromate	..	..	1 oz.	35–50 gms.
Water	..	..	20–30 ozs.	1,000 c.c.s.
Liquor ammonia (0.880)	..	..	60 minims	6 c.c.s.

A longer immersion in the weaker solution is practically equal to a shorter one in the stronger bath.

If the tissue is squeegeed on a glass plate after sensitising, the degree of squeegeeing (light or heavy) also modifies its sensitiveness by removing more or less of the solution. If the tissue be squeegeed on to a ferrotype plate, and allowed to dry upon it, the drying may be done in the light of an ordinary room. The face of the tissue is then protected from light, dust, and injurious vapours.

The following has been recommended:—

Potass. bichromate	.. ..	1 oz.	20 gms.
Water	.. ..	50 ozs.	1,000 c.c.s.
Citric acid	.. ..	$\frac{1}{2}$ oz.	5 gms.
Liquor ammonia	.. ..	q.s. to change tint of solution to lemon yellow.	

This bath is suitable for thin negatives, *i.e.*, those lacking in contrasts, and the tissue sensitised in it will keep longer than that sensitised in the former solution. The tissue, however, is much less sensitive, and with vigorous or contrasty negatives, such as are best suited for carbon work, it is apt to yield prints that are hard, through the washing away of the more delicate tones in the development.

FIXING OR HARDENING BATH.

Alum	.. ..	1 oz.	50 gms.
Water	.. ..	20 ozs.	1,000 c.c.s.

Waxing Solutions.

FOR CARBON PRINTS, OR FOR REMOVING COLLODION FILMS.

No. 1.—Beeswax	.. ..	20 grs.	10 gms.
Benzole rect. No. 1	.. ..	4 ozs.	1,000 c.c.s.

FOR FLEXIBLE SUPPORTS (AUTOTYPE).

No. 2.—Yellow resin	.. ..	180 grs.	42 gms.
Yellow beeswax	.. ..	60 grs.	14 gms.
Rectified spirits of turpentine	.. ..	10 ozs.	1,000 c.c.s.

Gelatine Solutions.

For transferring carbon pictures from flexible support to ivory, opal, glass, &c.

Nelson's No. 1 gelatine	.. ..	1 oz.	50 gms.
Water	.. ..	1 pint	1,000 c.c.s.
Chrome alum, dissolved in 2 ozs. (100 c.c.s.) hot water	.. ..	12 grs.	1.4 gm.

For coating drawing-papers for the single transfer process—

Nelson's No. 1 gelatine	.. ..	1 oz.	50 gms.
Water	.. ..	1 pint	1,000 c.c.s.
Chrome alum, dissolved in 2 ozs. (100 c.c.s.) water	.. ..	20 grs.	2.3 gms.

Apply with a brush.

Note.—In adding a solution of chrome alum to one of gelatine, both solutions should be at a fairly high temperature, 130 degrees to 160 degrees F.

SUBSTRATUM FOR CARBON TRANSPARENCIES.

Nelson's No. 1 gelatine	3 oz.	37 gms.
Water	20 ozs.	1,000 c.c.s.
Potass. bichromate	12 grs.	1.4 gm.

Well cleaned plates are coated with this and dried, when they are fully exposed to light, which will render the coating insoluble.

TO REMOVE BICHROMATE STAINS FROM FINGERS, NAILS.

Apply dilute ammonia to the parts until the stains disappear, then well wash the hands with warm water and soap.

THE OIL PROCESS.

Procedure.—Gelatine-coated paper is sensitised with bichromate, printed under the negative, and treated in cold water. The faint image has the power of fixing greasy ink. This is applied with a brush, usually accentuating or suppressing parts of the subject at the worker's discretion.

Double-transfer papers, as used in the carbon process or other papers (gelatine-coated), sold for the purpose, are sensitised in a solution of bichromate of potash of 5 per cent. strength as for carbon printing. The citric acid sensitiser given above under "Carbon" is very suitable, but the most satisfactory method on the whole is the use of a quick-drying spirit sensitiser.

SPIRIT SENSITISER.

(Demachy.)

Prepare 6 per cent. ammonium bichromate by dissolving $1\frac{1}{2}$ ozs. of this salt in 25 ozs. of water.

To make the sensitiser mix at time of use:—

Stock bichromate solution	1 part
Alcohol, pure, 90°	2 parts

The sensitiser is applied with a flat hog-hair brush, about $\frac{3}{4}$ oz. serving for six 10×8 sheets of transfer paper.

The paper dries in about 18 minutes, and is printed under the negative until it shows a brown image as in the platinum printing process. The detail should show in the high-lights. It is then soaked in several changes of water to remove the yellow bichromate (about 20 minutes), and then soaked for a further time (in a dish of water), depending on the thickness of the gelatine coating. An average time is 30 minutes; 2 to 3 hours for more heavily coated papers. The temperature of the water should be between 65° and 70° F., and should be kept steady by placing the dish in a place at this temperature. The print can be pigmented forthwith, or dried for pigmenting later on. If it is dried it requires about an hour's soaking in water at 65° to 70° F. to bring it into the best condition for pigmenting.

THE BROMOIL PROCESS.

In this form of the oil process a bromide print or enlargement is treated so as to remove the image and at the same time bring the print into the same condition as that produced by exposure of sensitised paper in the oil process.

C. Welborne Piper's Formula.

The bromide enlargement must be fully exposed and developed, using a slow-acting amidol developer for preference, and it must be thoroughly fixed, washed, and dried. It is then bleached in—

Ozobrome solution	..	..	..	4 parts
Potash alum, 10% solution	..	..	..	4 parts
Citric acid, 10% solution	..	..	..	1 part
Water to make	..	..	..	20 parts

It is washed and then immersed in sulphuric acid (1 part to 20 water) for from 2 to about 5 minutes, again washed by soaking for a few minutes, and then fixed for 2 or 3 minutes in—

Hypo	..	..	..	..	2 ozs.
Soda sulphite	..	..	..	..	$\frac{1}{2}$ oz.
Water to make	..	..	..	..	20 ozs.

After this it is washed again and then pigmented like an ordinary oil print. The solutions and washing water used should not be under 60 deg. or over 70 deg. F., and the preparation of the print should not occupy longer than 20 minutes.

The ozobrome solution used is that specially supplied for bromoil by the Ozobrome Company.

The above is the process originally published by Mr. Welborne Piper, and is still as reliable a method as any. For alternative bleachers, &c., which have been proposed, see "Epitome of Progress," B.J.A., 1909, p. 618; 1910, p. 571; 1911, p. 587; 1912, p. 628; 1913, p. 672; 1914, p. 671; 1915, 490, and under "Bromoil" in the present volume.

Pigmenting Oil and Bromoil Prints.

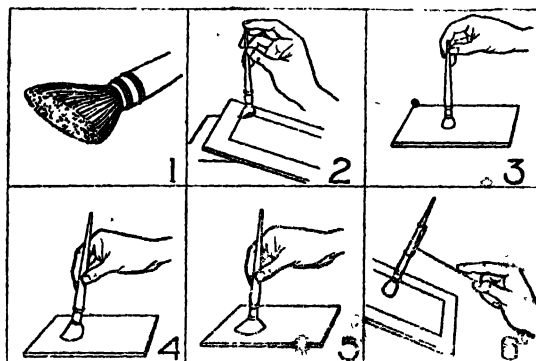
The brush chiefly used is the pied de biche, or hare's foot, of dome shape (Fig. 1).

In dabbing on pigment, rest elbow on table, press bristles at toe of brush first on paper, and bend and spread a little before heel comes down (Fig. 2).

Another touch is to hold brush lightly between first two fingers and thumb, lower brush on to print, and dab four or five times a second, the brush hardly leaving surface (Fig. 3).

Or hold brush (firmly) lower down (Fig. 4).

And apply vigorously, with slight dragging action, from heel to toe for strong effects (Fig. 5).



In "hopping," hold brush on wire and apply in taps, coming an inch or so from print each stroke (Fig. 6); lightens light and strengthens dark tones.

PLATINUM PRINTING.

In the platinum process, paper is coated with a mixture of sensitive iron (ferric) salts with which are platinum salts. By exposure to light the ferric salts become reduced to ferrous salts, and then are able to reduce the platinum in the paper as a black or sepia deposit, forming a highly permanent print. The "developer" in which this takes place is a solution by which the ferrous salts are brought into a soluble state. The developer is used hot or cold, according to the nature of the paper and the kind of tone required.

Sensitisers for Cold Bath Papers (Hübl).

STOCK SOLUTIONS.

Standard Iron Solution.—In glass measure about 3 ins. diameter and 12 ins. high (marked to show a volume of 85 c.c.s.) place 52 gms. powdered iron ammonium alum, and add about 20 c.c.s. ammonia

(0.880) and 20 c.c.s. water. Stir up the alum powder with a glass rod, and allow to stand several minutes, with frequent shaking. The whole should smell slightly of ammonia; if it does not a little more is added. The measure is then filled with water, the precipitate of ferric hydroxide stirred up, the glass rod removed, and the ppt. left to settle. The clear liquid is poured off, fresh water poured on, and the stirring and settling repeated until the solution no longer colours red litmus-paper blue. Powdered oxalic acid (21.5 gms.) is then dusted on the ppt., after pouring off the last washing water, and (in yellow light from this point) stirred in until the mixture clears. It is poured into a 100 c.c. measure, and diluted (with rinsings from the cylinder) to 100 c.c.s. Process occupies three to four hours.

Lead-Iron Stock Solution.—Dissolve lead acetate (10 gms.) in warm water (100 c.c.s.), and add oxalic acid (4 gms.) dissolved in a little water. A white precipitate of lead oxalate is produced, and is filtered, washed, and shaken up, with Standard Iron Solution in proportion of 1 gm. per 100 c.c.s. Finally, filter.

Oxalic-Gelatine Solution.—Soak gelatine (2 gms.) in water (20 c.c.s.), and add oxalic acid ($\frac{1}{2}$ gm.). Warm before use. Keeps only a day or two.

Stock Platinum Solution.—Potash chloroplatinate, 1 gm.; water, 6 c.c.s.

Mercury Citrate Solution.—Dissolve yellow mercuric oxide (1 gm.) in water, 20 c.c.s.; citric acid, 5 gms., warm and filter.

SENSITISERS.

The quantities are for a 20 by 30 inch sheet. Water is added for medium (2 to 3 c.c.s.) and for rough (3 to 8 c.c.s.) papers.

A.—Lead-iron solution 4.5 c.c.s.

Stock platinum solution 3 c.c.s.

For black tones on gelatine-sized Rives papers.

B.—Lead-iron solution 4.5 c.c.s.

Stock platinum solution 3 c.c.s.

Oxalic-gelatine solution 1 c.c.

For blue-black tones on arrowroot-sized papers.

For more brilliant prints 5 to 10 drops of 10% solution of sodium chloroplatinate are added to either of the above.

Sepia Paper Sensitisers.

HOT DEVELOPMENT.

Standard iron solution 6 c.c.s.

Stock platinum solution 4 c.c.s.

Mercuric chloride (1 in 20 solution) .. 0.2 to 1 c.c.

Sodium chloroplatinate (10% solution) .. 2 to 10 drops.

COLD DEVELOPMENT.

Standard iron solution 8 c.c.s.

Stock platinum solution 4 c.c.s.

Mercury citrate solution 1 to 4 c.c.s.

Sodium chloroplatinate (10% solution) .. 2 to 5 drops.

For rough papers 2 to 4 c.c.s. of water are added.

Procedure in the Platinum Process.—Prints are developed by floating for from 15 seconds to 1 minute on a bath, the chief chemical in which is always potash oxalate. Without washing, they are placed in a bath (No. 1) of 1 in 80 pure hydrochloric acid for 5 minutes, into a second bath for 5 minutes, again into a third, and are then washed in running water for 15 minutes. Time in all, about half-an-hour.

Cold Bath Developers.

Potass. oxalate	.. ..	2 ozs.	100 gms.
Potass. phosphate	.. ..	1 oz.	50 gms.
Water	.. ..	20 ozs.	1,000 c.c.s

FOR SEPIA TONES ON COLD-BATH BLACK PAPER.

A.—Potass. oxalate	.. ..	2 ozs.	20 gms.
Water	.. ..	15 ozs.	150 c.c.s.
B.—Potass. citrate	.. ..	160 grs.	23 gms.
Citric acid	.. ..	250 grs.	39 gms.
Mercuric chloride	.. ..	95 grs.	14 gms.
Water	.. ..	15 ozs.	1,000 c.c.s.

Equal parts of A and B, used slightly warm. The prints are afterwards fixed in acid baths of one-third the usual strength.

Another Formula.

Prepare the following solutions:—

1.—Potass. oxalate	4 ozs.	250 gms.
Distilled water	16 ozs.	1,000 c.c.s.
2.—Cupric chloride	124 grs.	35 gms.
Distilled water	8 ozs.	1,000 c.c.s.
3.—Mercuric chloride	1 oz.	62 gms.
Distilled water	16 ozs.	1,000 c.c.s.
4.—Lead acetate	32 grs.	18 gms.
Distilled water	4 ozs.	1,000 c.c.s.

Mix 12 parts of No. 1 with 4 parts No. 2, then add 4 parts No. 3 and 1 part No. 4, and heat till the precipitate first formed is redissolved. The solution should be heated to 175 degrees F., and the prints developed in it in the usual way and treated to the usual acid clearing baths, then immersed in ammonia solution (about 10 minims per oz.) for 5 minutes, and washed and dried.

Developer for Sepia Paper.

HOT BATH.

Potass. oxalate	2 ozs.	100 gms.
Potass. phosphate	1 oz.	50 gms.
Citric acid	180 grs.	20 gms.
Potass. chloride	90 grs.	10 gms.
Water	20 ozs.	1,000 c.c.s.

Various Platinum Formulæ.

RECOVERING OVER-EXPOSED PRINTS.

Immerse for about two minutes in the oxalate developer. Transfer for one second to a bath of 1 to 20 hydrochloric acid. Return to the developer, and treat as usual.

INTENSIFIER FOR PLATINUM PRINTS.

A.—Sodium formate	45 grs.	100 gms.
Water	1 oz.	1,000 c.c.s.
B.—Platinum perchloride	10 grs.	1 gm.
Water	1 oz.	45 c.c.s.

Add 15 minims each of A and B to 2 ozs. of water (3 c.c.s. to 100 c.c.s.)

RESTORING YELLOWED PRINTS.

Shake up bleaching powder with about five times its weight of water, pass through a sieve, and to the portion which passes through add a little weak hydrochloric acid—enough to give the mixture a faint chlorine smell. The solution removes the yellow (iron) stain from platinum prints.

CLEANING SOILED PRINTS.

Alum (one teaspoonful) is dissolved in about 8 ozs. of water, and mixed in a basin with a handful of flour to a cream-like consistency. This mixture is applied to the platinum print with a soft brush, and washed off in running water.

PLATINUM RESIDUES.

Exhausted developers—and the acid baths if in quantity—are mixed in a large jar, with zinc and hydrochloric acid (spirits of salt will do). A dirty chalk-like precipitate is accumulated, and the clear liquor is thrown away. The platinum is precipitated in the mud, and the latter, when enough has accumulated, is sent to the refiners, after being drained from water as much as possible on a linen cloth.

Waste prints, clippings from paper, etc., should be sent as they are or burnt to an ash in a place free from draught, such as a biscuit tin with a row of holes about half way up. They should not be mixed with the wet residues, as the two require different treatment for the extraction of the metal.

IRON PRINTING PROCESSES.

Ferro-Prussiate Sensitiser.

This ferro-prussiate or "blue" paper gives prints of Prussian blue colour from ordinary (brilliant) negatives. From line drawings, plans, etc., it supplies copies in white lines on a blue ground.

A.—Ferro ammonium citrate (green)*	.. ..	110 grs.	250 grs.
Water	.. ..	1 oz.	1,000 c.c.s.
B.—Potass. ferricyanide	.. ..	40 grs.	90 grs.
Water	.. ..	1 oz.	1,000 c.c.s.

Mix in equal parts, keep in the dark, and filter just before use.

The sensitiser is applied with a brush or sponge. The paper is printed until the shadows bronze, and is "developed" simply by soaking in one or two changes of plain water.

Solution for Writing Titles on, removing blue lines from, blue prints, etc.—Potass. oxalate, 75 grs. per oz.; 170 grs. per 1,000 c.c.s.

Brightening the Colour.—Blue prints are improved in colour by a final bath of 2½ per cent. alum solution, 3 per cent. oxalic acid, or 1 per cent. hydrochloric acid.

The Kallotype Process.

Paper, sensitised as below, is printed to a semi-visible image, like platinum paper. It yields prints from black to sepia, according to the developer. If prints are fixed in a mixture of hypo and ammonia, the results appear to be permanent.

SENSITISER.

Ferric oxalate (pure and fresh)	
20% sol.	1 oz.
Ferric potass. oxalate, 1 : 16 sol.	½ oz.
Oxalic-ammonia sol. as below	30 minims
Potass. bichromate, 1 : 16 sol.	4 drops
Silver nitrate	36 grs.

The oxalic-ammonia solution is:—Oxalic acid, 240 grs.; ammonia, .880, 100 minims; water, 4 ozs.

Paper thus sensitised yields prints of full gradation and half-tone from ordinary negatives, such as print well in P.O.P. For flat negatives further bichromate solution may be used in the developer.

* If the ordinary brown citrate be used, the formula should contain 80 grs. (188 grs.), and the ferricyanide should be increased to 60 grs. (137 grs.).

DEVELOPERS.

For Black Tones.

Borax	..	..	..	2 ozs.	100 gms.
Rochelle salt	..	..	..	1½ ozs.	75 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
Potass. bichromate sol. (1%)	15-18 drs.	90-115 c.c.s.

For Purple Tones.

Borax	..	..	..	½ oz.	28 gms.
Rochelle salt	..	..	..	2 ozs.	100 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
Potass. bichromate sol. (1%)	15-18 drs.	90-115 c.c.s.

For Sepia Tones.

Rochelle salt	..	..	..	1 oz.	50 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
Potass. bichromate sol. (1%)	..	..	..	8-10 drs.	50-60 c.c.s.

Prints are allowed to remain in either of the above developers for from 15 to 30 minutes.

For Black Tones.

Sodium acetate	..	..	..	3 ozs.	150 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

From this developer prints must be passed into a bath of potass. oxalate (15 %) before fixing.

FIXING SOLUTION.

Hypo	..	..	..	1 oz.	200 gms.
Ammonia (0.880)	..	..	..	120 minims	12 c.c.s.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Prints are left in this for at least 10 minutes.

Sepia Paper.

This process and the single-solution sensitiser given below may be used for printing from ordinary negatives, but the results are deficient in gradation. Both are excellent for making duplicates of plans, etc., and give a copy in white lines on a brown ground from an ordinary tracing. This copy may be used as a negative for preparing further "positive" copies.

A.—Ferrio ammonia citrate (green)	..	..	..	110 grs.	250 gms.
Water	..	..	..	1 oz.	1,000 c.c.s.
B.—Tartaric acid	..	..	..	18 grs.	40 gms.
Water	..	..	..	1 oz.	1,000 c.c.s.
C.—Silver nitrate	..	..	..	45 grs.	100 gms.
Water	..	..	..	1 oz.	1,000 c.c.s.
D.—Gelatine	..	..	..	30 grs.	70 gms.
Water	..	..	..	1 oz.	1,000 c.c.s.

Equal parts (say 1 oz. of each) of these solutions are mixed as follows:—D is rendered just fluid on a water bath, A and B added, and lastly C, a few drops at a time. The prints are fixed in 1:50 hypo.

One-Solution Sepia Sensitiser.

Silver nitrate	.. .. .	55 grs.	3.5 gms.
Water	.. .. .	4.5 drs.	15-20 c.c.s.

Add ammonia drop by drop just to re-dissolve the white precipitate, and then a little sulphuric (or citric) acid just to remove the odour of ammonia. Then add—

Ferric ammonium citrate (green)	40 grs.	2.5 gms.
Water	.. .. .	6 drs.
		25 c.c.s.

This solution keeps in the dark, and is used like the four-solution mixture.

Pellet Process.

The Pellet process is for copies of line drawings only. From an ordinary tracing it gives a copy in blue lines on a white ground.

A.—Pure gum arabic	.. .. .	4 ozs.	200 gms.
Water	.. .. .	20 ozs.	1,000 c.c.s.
B.—Ferric ammonium citrate	.. .. .	10 ozs.	500 gms.
Water	.. .. .	20 ozs.	1,000 c.c.s.
C.—Ferric chloride (crystallised)	.. .. .	10 ozs.	500 gms.
Water	.. .. .	20 ozs.	1,000 c.c.s.

Add 8 vols. of B, then 5 vols. of C to 20 vols. of A, in small doses with constant stirring.

The prints are developed on 10 per cent. solution of potass. ferrocyanide and "fixed" in 1:25 sulphuric acid (specific gravity 1.84).

The Ferro-Gallic Process.

This process is for line drawings only. It gives a copy, in bluish-black lines on a white ground, from an ordinary tracing.

Gum arabic	.. .. .	60 grs.	135 gms.
Warm water	.. .. .	1 oz.	1,000 c.c.s.

When dissolved add the following in the order given:—

Tartaric acid	.. .. .	8 grs.	18 gms.
Salt ..	.. .. .	36 grs.	81 gms.
Ferric sulphate	.. .. .	40 grs.	90 gms.
Ferric chloride	.. .. .	60 grs.	135 gms.

The developer for the prints is:—Alum and gallic acid, 1 part of each; water, 80 parts.

MOUNTANTS.

Starch Paste.

Pure starch is mixed with a very small proportion of cold water to form a very stiff mass. It should be so stiff that it is stirred with difficulty. Perfectly boiling water is then poured in, about 12 ozs. for every ounce of starch. On stirring, the mixture will jelly without being boiled; but if it does not it is brought to the boil, cooled, the skin taken off, and the paste used on day of making.

Gelatine.

For mounting prints without cockling.

Nelson's No. 1 gelatine ..	4 ozs.	50 gms.
Water	16 ozs.	200 c.c.s.

Soften the gelatine in the water, liquefy on the water bath, and add a little at a time and stirring rapidly:—

Methylated spirit ..	5 ozs.	60 c.c.s.
Glycerine	1 oz.	12 c.c.s.

The mountant is used hot. A piece of ground glass is dipped in hot water, drained, and the mountant brushed over. The print is then laid face up on the pasted surface and rubbed gently in contact with a piece of paper, being then removed and pressed down on its mount.

Dextrine Paste.

Dextrine, best white..	2½ lbs.	1,400 gms.
Water at 160° F. ..	80 ozs.	2,550 c.c.s.
Oil of wintergreen ..	15 minims	1 c.c.
Oil of cloves	15 minims	1 c.c.

Place the water in a vessel standing in a larger vessel of water kept to within 1° of 160° F. Stir in the dextrine slowly, and when it has all dissolved add the two preservative oils, stirring all the time. Then allow to cool, pour into bottles, and cork. Put aside in a cool place for a week or two for the mixture to congeal to a firm white smooth paste.

Starch-Gelatine.

A.—Bermuda arrowroot ..	8 ozs.	200 gms.
Water	4 ozs.	100 c.c.s.
B.—Nelson's No. 1 soft gelatine ..	360 grs.	10 gms.
Water	64 ozs.	800 c.c.s.

The gelatine is first softened in the water and A and B are then mixed together and boiled for a few minutes. To the cold mixture are stirred in—

Methylated spirit ..	5 ozs.	250 c.c.s.
Carbolic acid (liquid) ..	25 minims	3 c.c.s.

This is a good cold paste, which sticks and keeps fairly well.

Liquid Gelatine.

Gelatine	1 oz.	100 gms.
Water	6 ozs.	600 c.c.s.
Chloral hydrate	1 oz.	100 gms.

The gelatine is dissolved in the water by aid of heat, and the chloral hydrate added. After digesting for a short time the adhesive liquid is neutralised with a little sodium carbonate solution.

Gum-Dextrine.

Picked white gum arabic ..	$\frac{1}{2}$ oz.	65 gms.
Dextrine	$2\frac{1}{2}$ ozs.	280 gms.
Liquid ammonia	4 drops	50 c.c.s.
Carbolic acid	1 dr.	15 c.c.s.
Water	8 ozs.	1,000 c.c.s.

The gum is powdered in a mortar and mixed intimately with the dextrine, and rubbed with 2 ozs. of water until a smooth mixture is obtained. The remainder of the water is added, and the whole boiled for 10 minutes. The ammonia and carbolic acid are added when cold. This mountant keeps well for months, and is smooth in working and of great adhesiveness.

Shellac Mountant.

A strong solution of shellac in methylated spirit, or, better, rectified spirit, is thinly applied to both mount and print, and the two coated surfaces quickly rubbed into contact. A good method of fixing prints to thin mounts in albums, etc.

Affixing Paper to Metal.

Tragacanth	3 ozs.	60 gms.
Gum arabic	12 ozs.	240 gms.
Water	50 ozs.	1,000 c.c.s.

or—

Gum arabic	1 oz.	100 gms.
Aluminium sulphate	45 grs.	10 gms.
Water	10 ozs.	1,000 c.c.s.

Mounting on Glass (Opalines).

Nelson's No. 2 soft gelatine ..	2 ozs.	30 gms.
Water	20 ozs.	300 c.c.s.

The gelatine is soaked in the water, and liquefied by standing the vessel in hot water. The solution is thinned down until nearly as thin as water. Print and glass are immersed, removed together, and squeezed together with flat rubber squeegee.

WORKING UP, COLOURING, ETC., PRINTS.

Lubricant for Burnishing Prints.

Powdered Castile soap	..	..	20 grs.	5 gms.
Alcohol	..	..	10 ozs.	1,000 c.c.s.

Encaustic Paste.

Purified beeswax	..	..	..	..	50 parts
Oil of lavender..	..	..	..	..	30 parts
Benzole..	..	..	..	..	30 parts
Gum elemi	..	..	..	..	1 part

BASKETT'S FORMULA.

To the contents of a 2d. tin of Globe polish add 1 oz. best olive oil and 1 oz. terebine. Apply with soft cloth and polish.

Preparing Prints for Colouring.

P.O.P.'s AND GLOSSY BROMIDES.

Rub the prints lightly with a tuft of wool slightly moistened with artist's purified ox-gall. If they have been lubricated before burnishing apply previously a little alcohol in the same way.

COLLODION PRINTS.

Fluid extract of quillaia	..	..	1 dr.	5 c.c.s.
Water	..	..	1 oz.	40 c.c.s.
Alcohol	..	..	1 oz.	40 c.c.s.

BROMIDES.

For Water Colouring.

Apply ox-gall as directed for P.O.P., or prepare as directed below for pastel work.

For Oil Colouring.

If the surface is clean no preparation is needed; if otherwise give a wash of gum, starch, or gelatine, or prepare with pumice powder. Also light drying oil (from the artists' colourman) may be rubbed over with a tuft of wool or the fingers. It dries in about twenty-four hours, and leaves the surface of the bromide ready for painting.

For working up in pastel or black and white, apply fine pumice powder with a tuft of wool, and remove with another piece of wool or a duster.

Fixative for Crayon and Pastel Work.

A.—Mastic	..	..	24 grs.	1.6 gm.
Amyl acetate	..	..	3 ozs.	85 c.c.s.

Dissolve by agitation, and allow to stand some hours before use.

B.—Celluloid (film clippings free from emulsion will do)	.. ..	7 grs.	0.45 gm.
Amyl acetate	.. ..	3 oss.	85 c.c.s.

Dissolve by agitation. Mix when both are clear, and keep in tightly-corked bottle. Apply with spray diffuser.

Colouring Prints with Dyes.

Dissolve the aniline colour (1d. packets of dye will do) in a sufficient quantity of water (from $\frac{1}{2}$ to 1 oz. to a 1d. packet), and for glossy prints add a little gum. If the work affects the gloss when finished, rub the print over with a piece of wool slightly moistened with a solution of wax in benzole.

Colouring Prints with Artists' Water Colours.

The following are suitable colours for bromide enlargements, platinum, and carbon prints. The colours in ordinary type are permanent; those in italics are more or less doubtful except under special precautions against exposure. Those marked * are transparent.

* Alizarin Scarlet.	' Prussian Blue.	* Hooker's Green, No. 2.
<i>Flesh Tint, No. 1.</i>	' <i>Brown Pink.</i>	Terre Verte.
Flesh Tint, No. 2.	' Burnt Sienna.	* <i>Brown Madder.</i>
Flesh Tint, No. 3.	Cadmium Yellow.	<i>Payne's Grey.</i>
* Indian Red.	<i>Chrome Lemon.</i>	Raw Umber.
* Rose Madder.	<i>Chrome Orange.</i>	Sepia.
Venetian Red.	* Indian Yellow.	* <i>Vandyke Brown.</i>
Vermilion.	Naples Yellow.	Ivory Black.
* Antwerp Blue.	' Raw Sienna.	Lamp Black.
Cobalt Blue.	Roman Ochre.	Chinese White.
* French Ultramarine	Yellow Ochre.	
Indigo.	<i>Emerald Green.</i>	

Colours for Air-brush Work.

The following is a list of the most useful colours for air-brush work:—

Blanc d'Argent, No. 2.	Lamp Black.	Ultramarine, Light.
Burnt Sienna.	Light Red.	.. Middle.
Burnt Umber.	Mauve.	.. Deep.
Charcoal Grey.	Naples Yellow.	Vandyke Brown.
Chinese White.	Neutral Tint.	Vermilion.
Chrome Lemon.	Permanent Crimson.	Yellow Ochre.
Chrome Yellow.	Permanent Green.	Brown Madder.
Chrome Deep.	Permanent Scarlet.	Emerald Oxide of
Chrome Orange.	Prussian Blue.	Chromium
Cologne Earth.	Raw Sienna.	Indian Yellow.
Emerald Green.	Raw Umber.	Sepia.
Indian Red.		

Spotting Bromide Prints.

Mix together Payne's grey and Indian ink (the colour should match that of the film).

Spotting P.O.P. Prints.

Add a little carmine to the above. When mixture is dry (on the palette) work in a strong solution of gum, rubbing the brush one way only, to avoid making air-bells. If the prints are to be enamelled or glazed by stripping after spotting, then artists' oil colours with benzole in which gum dammar has been dissolved, or water colours, may be used with shellac water varnish. (See "Negative Varnishes.")

Colouring from Behind (Crystoleum).

The print (which should be albumen) is mounted with a warm solution of:—

Hard gelatine	..	..	..	20 grs.	45 grs.
Water	..	..	..	1 oz.	1,000 c.c.s.

containing a little salicylic acid to keep it. Or with a cold mountant made by mixing the above with an equal amount of starch paste.

VARNISH FOR "TRANSLUCING."

Canada balsam	..	..	..	5 ozs.	100 grs.
Solid paraffin	..	..	..	2 ozs.	40 grs.
White wax	..	..	..	2 ozs.	40 grs.

which is melted, the picture immersed, and the whole kept as cool as possible consistent with remaining fluid.

COLOUR PHOTOGRAPHY.

The following are the official working instructions for the screen-plates freely in the market at the time of sending this portion of the ALMANAC to press (November 15, 1916):—

The Autochrome Plate.

SIMPLIFIED METHOD OF DEVELOPMENT.

Two solutions only are used—developer (used also for re-development) and reversing solution. There is no need to fix.

Developer—Stock Solution.

A.—Water, distilled	35 ozs.	1,000 c.c.s.
Metoquinone (Quinomet)	$\frac{1}{2}$ oz.	15 grs.
Soda sulphite, anhydrous	$3\frac{1}{2}$ ozs.	100 grs.
Liquor ammonia, '920	9 drams	32 c.c.s.
Potass. bromide	90 grs.	6 grs.

Dissolve the Quinomet in warm water (about 100° F.), add the sulphite, and then, when cold, the ammonia.

Working developer: Stock solution, above, 1 part; water, 4 parts.

For correct exposure, time of development is $2\frac{1}{4}$ minutes exactly; then rinse and immerse in reversing solution, C below.

Where exposure may not be correct, it is best to develop by the following table, allowing of errors being compensated for:—

For half-plate, place in developing dish.

C.D.—Stock solution, A above	85 minims	5 c.c.s.
Water	$2\frac{1}{2}$ ozs.	80 c.c.s.

Have ready in one measure glass—

Stock solution, A above	$\frac{1}{2}$ oz.	15 c.c.s.
and in another—		
Stock solution, A above	$1\frac{1}{2}$ ozs.	45 c.c.s.

These are placed near the lamp, one or the other quantity of the developer being quickly added to that in the dish, according as the plate comes up quickly or slowly.

Immerse the plate in solution CD, and count the number of seconds elapsing before the first outlines of the image appear (disregarding the sky) by looking at the plate rapidly without taking it out of the dish. Immediately these outlines are discernible, pour into the dish either 15 c.c.s. ($\frac{1}{2}$ oz.), or 45 c.c.s. ($1\frac{1}{2}$ oz.) of A, whichever may be necessary according to the following table, continuing to count the seconds:—

Appearance of outlines of image (disregarding sky) after immersion.	Quantity of developer A to add on appearance of first outlines.	Total duration of development from immersion of plate.	
Seconds.		Minutes.	Seconds.
12 to 14	15 c.c.s. ($\frac{1}{2}$ oz.)	1	15
15 to 17	do. do.	1	45
18 to 21	do. do.	2	15
22 to 27	do. do.	3	0
28 to 33	do. do.	3	30
34 to 39	do. do.	4	30
Extreme under- exposure)	40 to 47	3	0
	Above 47	4	0

For a quarter-plate use one-half the above quantities.

REVERSING SOLUTION.

C.—Potassium permanganate	30 grs.	2 gms.
Sulphuric acid	3 drams	10 c.c.s.
Water	35 ozs.	1,000 c.c.s.

This solution will keep for a short time, but should not be used if cloudy.

Immediately the plate is covered by the C solution daylight may be used. After 3 or 4 minutes, wash for 30 seconds in running water.

In summer it is well to put the plate, after leaving the C bath, for 2 minutes into a solution of chrome alum, as follows:—

Chrome alum	150 grs.	10 gms.
Water	35 ozs.	1,000 c.c.s.

The plate should be rinsed before placing in the second developer, or, if desired, it may be dried and re-developed after a day or two.

Second Development.—The plate is then re-developed in full daylight, using the solution which has served for the first development (kept in the dish without special precautions). When the high-lights are completely darkened (about 3 or 4 minutes) the plate is washed for 3 or 4 minutes, and immediately placed to dry. Fixing is unnecessary unless the plate is intensified.

PYRO DEVELOPMENT.

The following method, which was that originally advised for the development of Autochrome plates, is still preferred by some workers. The solutions are as follows:—

FIRST DEVELOPMENT.

A.A.—Water	3½ ozs.	100 c.c.s.
Soda bisulphite solution	2 drops	2 drops
Pyro	45 grs.	3 gms.
Potass bromide	45 grs.	3 gms.
B.B.—Water	3 ozs.	85 c.c.s.
Soda sulphite, anhydrous	3 drams.	10 gms.
Ammonia 920	½ oz.	15 c.c.s.

Working developer:—

Water	3½ ozs.	100 c.c.s.
A.A.	3 drams.	10 c.c.s.
B.B.	3 drams.	10 c.c.s.

This developer serves for once only. Time of development (for correct exposure), 2½ minutes exactly at 60° to 65° F.

REVERSING BATH.

C. —As given above, and used as there directed.

SECOND DEVELOPMENT.

D.—Water, distilled	35 ozs.	1,000 c.c.s.
Soda sulphite, anhydrous	½ oz.	15 gms.
Dianol (Diamidophenol)	75 grs.	5 gms.

After a rapid washing, the plate is placed in the Dianol (Diamidophenol) developer D for 3 or 4 minutes. This should be performed in a strong light, and continued until the white portions are completely blackened. Over-development need not be feared.

There is no need for fixing the plate after the second development. It only requires washing, drying, and varnishing

CONTROLLED DEVELOPMENT WITH PYRO.

Make a quarter-strength pyro solution, viz. :—

bb Solution B.B..... 1 part
Water 3 parts

To make working developer for a half-plate take :—

Solution A.A..... 3 drams. 10 c.c.s.
Solution *b.b.* 3 drams. 10 c.c.s.
Water 3 ozs. 80 c.c.s.

And have ready in a small graduated measure $1\frac{1}{2}$ oz. (45 c.c.s.) of *b.b.* solution, to be added wholly or partly to the bath during development, if necessary.

As soon as the plate is in the dish, count the number of seconds from the moment of entering until the appearance of the first outlines of the image. The sky, however, should not be taken into consideration.

It is unnecessary to view the plate by the light of the lantern until 20 seconds have elapsed, as whatever be the degree of exposure the first forms will not be seen before 22 seconds.

The number of seconds elapsing before the appearance of the image is the guide to the further development of the plate, which should be carried out according to the following table: —

Time of first appearance of im- age counting sl	Quantity of ammonia solu- tion appears	Total time of development, including time of appearance.	
Seconds.	C.c.s.	Minutes	Seconds
22 to 24	None	2	0
25 to 27	2	2	15
28 to 30	8	2	30
31 to 35	15	2	30
36 to 41	20	2	30
42 to 48	25	2	30
49 to 55	30	2	45
56 to 64	35	3	0
65 to 75	40	4	0
over 75	45	5	0

The additional quantity of *bb* solution must be added when the outlines begin to appear.

We see by the above that, for example, when the image takes 28 seconds to appear we add 8 c.c.s. of *bb* solution and continue development until the expiration of 2 minutes 30 seconds from the time the plate was put in the dish.

INTENSIFICATION.

If, after the second development, the plate does not show sufficient contrast and brilliancy, it may be much improved by intensification.

This operation may take place at the time of development or be delayed, if desired, till a later time.

Whichever plan is followed, all traces of the developer must be first destroyed by the following operation:—

OXIDATION.

Immerse the plate for 10 or 15 seconds (after a wash of similar duration) in solution E, composed of:—

E. Water	35 ozs.	1,000 c.c.s
Solution C (Acid Permanganate) ..	5 drams	20 c.c.s.

which oxidises any traces of developer remaining in the coating, and allows proper intensification. Then wash the plate for a few seconds in running water.

For intensification prepare the two following solutions:—

F. Distilled water	35 ozs.	1,000 c.c. s.
Pyrogallie acid	45 grs.	3 gms.
Citric acid	45 grs.	3 gms.
G. Distilled water	3½ ozs.	100 c.c.s.
Nitrate of silver ..	75 grs.	5 gms.

For use take, —

Solution F.	3½ ozs.	100 c.c.s.
Solution G.	3 drams	10 c.c.s.

Immerse the plate in this solution and examine from time to time the increase of intensity. The solution turns yellow little by little, and eventually becomes turbid. It should be used as quickly as possible, and rejected when turbidity makes its appearance.

Usually intensification is complete before this state is reached, but should it be necessary to continue intensification, fresh solution should be used after a short wash, a few seconds in the oxidising solution (E), and another short wash.

During intensification the whites of the plate may become yellowish (dichroic fog). All traces of this disappear in the following clearing bath.

CLEARING.

After intensification, wash the plate for a few seconds and place in the following solution (H) of permanganate, containing no acid. Allow this to act from 30 seconds to 1 minute:—

H. Water	35 ozs.	1,000 c.c.s.
Potass. permanganate	15 grs.	1 gm.

Particular care should be exercised that Solution C (Acid permanganate) be not mistaken for Solution H (Neutral permanganate).

FIXING.

After a short wash, fix for about 2 minutes in an acid hyposulphite bath made as follows:—

I. Water	35 ozs.	1,000 c.c.
Hypo	5½ ozs.	150 gms.
Soda bisulphite, saturated solution	1½ ozs.	50 c.c.s.

The density of the image should not be reduced by fixing. Should reduction be found, it is caused either by too short second development or exposure to too weak a light during second development. Fixing is indispensable when the plate has been intensified.

WASHING.

A wash for 4 to 5 minutes is sufficient to clear the extremely thin gelatine coating of traces of hyposulphite. The plate is then put to dry. It may be that the whites of the subject still retain a slight yellowish tinge. If so, treatment by Neutral Permanganate (solution H) followed by use of the fixing bath I may be repeated.

The Omnicolore Plate.

The instructions and formulæ are those given above for the Autochrome, the same emulsion being used for both plates.

The Dufay (Dioptrichrome) Plate.

FIRST DEVELOPMENT.

The following developer is recommended to the exclusion of all other formulæ:—

Water	35 ozs.	1,000 c.c.s.
Metol	90 grs.	6 gms.
Sulphite of soda recrystallised	2½ ozs.	75 gms.
Hydroquinone	30 grs.	2 gms.
Potass. bromide.....	30 grs.	2 gms.
Ammonia .880	3½ drams	12 c.c.s.

(Ammonia at .880 being volatile and liable to loss, it is a convenient practice to dilute it on receipt with an equal bulk of distilled water, and then use double the quantity indicated above.)

For use take equal parts of the above developer and of water. This developer is adapted for automatic development, giving images with full detail and the maximum of intensity. The time of development at 60° F. should be 4 to 5 minutes. Fresh solution should be taken for each plate developed. The development should be begun in as nearly complete obscurity as possible. In about a minute after immersion in the developer it is permissible to examine the plate by a green safe light. Red light is in no case to be used, and it is advisable to expose the plates to the green light as little as possible. When the image is sufficiently developed, wash for about 20 seconds in running water, then place in the reversing solution.

REVERSING SOLUTION.

Water	35 ozs.	1,000 c.c.s.
Potass. bichromate	75 grs.	5 gms.
Sulphuric acid	170 minims	10 c.c.s.

Immediately the plate is covered with this solution admit daylight to the dark room or take the dish to an open door or well-lit window, as the rest of the operations should take place in full daylight. The reduced silver will gradually dissolve in the bichromate solution; the progress of the reversal and the appearance of the real colours may be seen on looking through the plate. When the

reversal is complete, which occupies about two minutes, wash in running water till the yellow stain, due to the bichromate, disappears.

SECOND DEVELOPMENT.

Then commence the second development by replacing the plate in the developer previously used for the first development. The image when it left the reversing solution consisted of a positive image in white silver bromide, which is reduced to a black deposit of silver by the action of the developer and daylight, or, failing that, of strong artificial light. The second development should be continued till the darkening action is complete, which will be in about 3 or 4 minutes in day-light.

FINAL WASHING.

Three or four minutes' washing in running water is sufficient although a longer time is not harmful.

INTENSIFICATION.

If over-exposed, the image appears too quickly on the first development, the ultimate result being a thin image with a washed-out appearance. This result may be improved to a certain extent by intensification. Bleach thoroughly in:—

Water	20 ozs.	800 c.c.s.
Alcohol	5 ozs.	200 c.c.s.
Bichloride of mercury.....	1 oz.	40 gms.

Then wash for 5 minutes and blacken in the following solution:—

Water	10 ozs.	100 c.c.s.
Soda sulphite, recryst.	1 oz.	10 gms.

The Paget Plate.

DUPLICATING METHOD.

A separate panchromatic plate is exposed behind and in contact with a mosaic three-colour taking screen, developed, fixed, washed and dried. From it a positive transparency is printed by contact. This transparency is then bound up in register with a mosaic three-colour viewing screen.

EXPOSURE.

The following particulars are given as a rough guide.

Open landscape, in good light with sunshine, stop $f/8$, cap off and on, or about $\frac{1}{2}$ of a second.

Portraiture, head and shoulders only; in diffused light out of doors, stop $f/8$, about 3 seconds.

Instantaneous exposures should not be attempted except in the brightest light, and never with a smaller stop than $f/6.5$, under which conditions the exposure may be about $\frac{1}{10}$ th of a second.

Actinometers are a reliable means of calculating the exposure, and the following speed numbers will be found correct:—

Watkins
15

Wynne
F24

These numbers represent the speed of the panchromatic plate with filter and taking screen in position ready for exposure.

DEVELOPMENT OF NEGATIVES.

The following developer may be used for developing the negative for the Paget Colour Process:—

A.	Pyro .. .. .	..	$\frac{1}{2}$ oz.	12.5 gms.
	Potassium metabisulphite ..	..	10 grs.	1.1 "
	Water to .. .. .	..	20 oz.	1,000 ccs.
B.	Soda carbonate (cryst) ..	..	2 ozs.	100 gms.
	Soda sulphite (cryst) ..	..	2 "	100 "
	Potassium bromide ..	..	10 grs.	1.1 gms.
	Water to .. .. .	..	20 ozs.	1,000 ccs.

For use take 1 part each A. and B. and 2 parts of water (making four parts in all) and develop for two minutes.

Paget Colour Developer is to be used according to the instructions on the bottle, but Rytol or any other developer may be used at half the usual strength and taking care not to obtain a hard negative.

Unless a green safelight is used development must take place in total darkness. On no account should a red light or one of any colour other than the safe green be used.

Rinse the plate and fix in the following bath:—

Hypo	6 ozs.
Potass. metabisulphite ..	$\frac{1}{2}$ oz.
Water	20 ozs.

Wash again for about 15 minutes, and put to dry.

MAKING THE TRANSPARENCY.

To obtain the best results the following conditions must be observed:—The transparency should be of black tone, perfectly clear, and free from fog, brilliant and full of detail. These conditions can be secured by using the special transparency plates and developer issued in connection with the process.

REGISTERING TRANSPARENCY WITH VIEWING SCREEN.

Standing well back in the room, facing the light, the operator holds the two plates together, film to film, the screen being towards him. The latter is then moved very slightly in a circular direction (the transparency being held rigid) until small squares are seen. The same circular direction being maintained the squares will grow larger until they disappear and patches of colour take their place. Continue the movement until a perfectly even tint (it does not matter of what colour) appears all over the transparency. The squares of the screen are now parallel with those of the transparency, and the slightest movement of the screen one way will give the picture in its correct colours. To determine the right direction the operator, still holding the screen and transparency tightly together, should turn them in a slanting position, viewing them from either the top, bottom, right or left, when from one of these points the correct colours will be seen. The screen should be moved very gently in this direction, when the proper colours will gradually appear. Clip the two together with a couple of bull-dog paper clips and bind them securely.

Binding must be carefully done, so as not to alter the position of the screen. Denison's binding strips will be found the best. Bind the two sides not clipped and see that the binding strip is adhering everywhere; then remove one clip at a time (the transparency should never be without one clip) and clip the sides already bound before binding the remaining two. Leave the clips in position until the binding is perfectly dry.

The viewing screens will register one way only, always lengthways of the plate. Therefore, if it is desired to take a portion of the picture from a large negative, say a quarter plate size from a half plate negative, the quarter plate transparency must be made lengthways of the negative and not across.

In the case of square cut plates such as $3\frac{1}{2} \times 3\frac{1}{2}$ a line will be found on the edge of the viewing screen showing the "lengthways" of the plate.

MISCELLANEOUS FORMULÆ.

Reversed Negatives by Ammonium Persulphate.

A lantern or other thinly coated slow plate is placed in contact with the negative in a printing frame and a full exposure given such as would be thought advisable in making a soft positive transparency. The plate is developed with a clean working developer (*e.g.*, glycin) until the shadows appear quite black on the glass side of the plate. The time of development may be five times as long as for an ordinary transparency. The latter is then washed and placed in a 2 per cent. solution of ammonium persulphate until the silver image is seen to be removed. The plate is then thoroughly washed and developed in any clean developer containing about half a grain of bromide per ounce. It is then fixed and washed and dried. After the first development the operations may be done in weak daylight or artificial light. The action of the persulphate should be as complete as possible, otherwise a veil is left over the negative. The above is a very rapid and economical process. Direct positives, but reversed from right to left, from engravings, etc., may be made in the camera by substituting bromide paper for the plate. The exposure should be full and the development as above. The method has this advantage, that the lines are rendered in the same degrees of black and grey as in the original, a point of some importance, since the lines in an engraving are seldom, if ever, of uniform blackness.

To Recover Fogged (Sensitive) Dry-Plates.

Soak for 15 minutes in the following bath, contained in a porcelain tank :—

Potass. bichromate	$\frac{1}{2}$ oz.	12.5 gms.
Ammonium bromide	$\frac{1}{2}$ oz.	12.5 gms.
Water	20 ozs.	1,000 c.c.s.

Wash for 30 minutes, wipe with a pad of cotton wool and stand aside—of course in the dark or by deep ruby light—to dry.

Backing Dry Plates.

Gum solution (ordinary office gum)	1 oz.	100 c.c.s.
Caramel	1 oz.	100 gms.
Burnt sienna, ground in water	2 ozs.	200 gms.

Mix and add—

Alcohol	2 ozs. (fl.)	200 c.c.s.
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The Dusting-on Process.

Best gum arabic	80 grs.	5.2 gms.
White sugar	60 grs.	4.0 gms.
Ammonium bichromate ..	60 grs.	4.0 gms.
Water	7 ozs.	200 c.c.s.
Methylated spirit	1 oz.	30 c.c.s.

This mixture will keep for a few days only, and after the plate has been coated and exposed it is developed with finest graphite powder, collodionised, and washed.

Ink for Rubber Stamps.

Aniline red (violet)	900 grs.	210 gms.
Boiling distilled water	10 oz.	1,000 c.c.s.
Glycerine about	$\frac{1}{2}$ oz.	60 c.c.s.
Treacle about	$\frac{1}{4}$ oz.	30 c.c.s.

Invisible Ink.

Chloride of cobalt.. ..	25 grs.	60 gms.
Distilled water	1 oz. (fl.)	1,000 c.c.s.

Writing executed with this ink is first pink on paper, becoming invisible on drying. On warming the writing turns blue.

Dead Black for Wood.

Borax	30 grs.	8 gms.
Glycerine	30 minims	8 c.c.s.
Shellac	60 grs.	16 gms.
Water	8 ozs	1,000 c.c.s.

Boil till dissolved and add—

Nigrosine, W.S.	60 grs.	16 gms.
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Or paint the wood first with—

Cupric chloride	75 grs.	75 gms.
Potass. bichromate	75 grs.	75 gms.
Water	2½ ozs.	1,000 c.c.s.

and as soon as the surface dries apply—

Aniline hydrochloride .. .	150 grs.	150 gms.
Water	2½ ozs.	1,000 c.c.s.

and wipe off any yellow powder that forms. Repeat the process till black enough, and then rub over with boiled linseed oil.

Waterproofing Solution for Wood.

Asphalt	4 ozs.	400 gms.
Pure rubber	30 grs.	6 gms.
Mineral naphtha	10 ozs.	1,000 c.c.s.

Apply with a stiff brush and give three successive coats, allowing to dry between each. The vapour from this solution is very inflammable.

Polish for Cameras, Woodwork, etc.

Linseed oil.. ..	20 ozs.	400 c.c.s.
Spirits of camphor	2 ozs.	40 c.c.s.
Vinegar	4 ozs.	80 c.c.s.
Butter of antimony	1 oz.	20 gms.
Liquid ammonia	¼ oz.	5 c.c.s.
Water	½ oz.	5 c.c.s.

This mixture is applied very sparingly with a bit of old flannel, and thoroughly rubbed off with soft rags.

Blackening Brass Work.

Copper nitrate	200 grs.	450 gms.
Water	1 oz.	1,000 c.c.s.

Place the brass work (perfectly cleaned) in the solution for a few moments, heating it on removal.

Varnish for Brass Work.

Celluloid	10 grs.	4 gms.
Amyl alcohol	½ oz.	100 c.c.s.
Acetone	½ oz.	100 c.c.s.

Instead of this cold celluloid varnish, commercial "cold lacquer" can be used.

To Blacken Aluminium.

Clean the metal thoroughly with fine emery powder, wash well, and immerse in—

Ferrous sulphate ..	1 oz.	80 gms.
White arsenic ..	1 oz.	80 gms.
Hydrochloric acid	12 ozs.	1,000 c.c.s.
Dissolve and add—		
Water ..	12 ozs.	1,000 c.c.s.

When the colour is deep enough dry off with fine sawdust, and lacquer.

Silvering Mirrors (Martin's Method).

(In employing the following formulæ, it should be well understood that the glass plate to be silvered must be scrupulously clean.)

A.—Nitrate of silver ..	175 grs.	40 gms.
Distilled water	10 ozs.	1,000 c.c.s.
B.—Nitrate of ammonium	262 grs.	60 gms.
Distilled water ..	10 ozs.	1,000 c.c.s.
C.—Pure caustic potash	1 oz.	100 gms.
Distilled water ..	10 ozs.	1,000 c.c.s.
D.—Pure sugar candy	½ oz. (avoir.)	100 gms.
Distilled water ..	5 ozs.	1,000 c.c.s.
Dissolve and add—		
Tartaric acid ..	50 grs.	23 gms.
Boll in flask for ten minutes, and when cool add—		
Alcohol ..	1 oz.	200 c.c.s.
Distilled water, quant. suff. to make up to 10 ozs. or 2,000 c.c.s.		

For use take equal parts of A and B. Mix together also equal parts of C and D, and mix in another measure. Then mix both these mixtures together in the silvering vessel, and suspend the mirror face downwards in the solution.

MISCELLANEOUS INFORMATION.

List of the Principal Works on Photography.

[The books mentioned below are obtainable by order of all photographic dealers.]

ELEMENTARY AND GENERAL TEXT-BOOKS.

- Amateur Photography.* By F. T. Beeson and A. Williams. 1s.
Ilford Manual of Photography. By C. H. Bothamley. 1s.
Sinclair Handbook of Photography. 1s. 6d.
Barnet Book of Photography. 1s. 6d.
A Primer of Photography. By Captain Owen Wheeler. 2s. 6d.
Early Work in Photography. By W. Ethelbert Henry. 1s.
Hand Camera Photography. By Walter Kilbey. 1s.
Photography in a Nutshell. By the Kornel. 1s.
Photographic Reference Book. By J. McIntosh. 1s. 6d.
The Science and Practice of Photography. By Chapman Jones. 5s.
Instruction in Photography. By Sir William Abney. 11th Edition.
 Revised and enlarged. 7s. 6d.
Dictionary of Photography. By E. J. Wall. 7s. 6d.
Cyclopaedia of Photography. Edited by Bernard E. Jones. 10s. 6d.
The Complete Photographer. By R. Child Bayley. 10s. 6d.
Photography. By Alfred Watkins. 6s.
Photography in Principle and Practice. By S. E. Bottomley. 3s. 6d.
Photography of To-day. By H. Chapman Jones. 5s.

COPYRIGHT AND PRESS PHOTOGRAPHY.

- Photographic Copyright.* By George E. Brown, F.I.C., and Alexander Mackie. 1s.
Photographs for the Papers. By John Everard. 1s.

PHOTOGRAPHIC OPTICS AND CHEMISTRY.

- Photographic Lenses: How to Choose and How to Use.* By John A. Hodges. 2s.

- *Photographic Lenses.* By Conrad Beck and Herbert Andrews. 1s.
- The Lens.* By Thos. Bolas and George E. Brown. 2s. 6d.
- The Optics of Photography and Photographic Lenses.* By J. Traill Taylor. 3s. 6d.
- System of Applied Optics.* By H. Dennis Taylor. 30s.
- Photographic Optics, a Treatise on.* By R. S. Cole. 6s.
- Photographic Optics.* By Otto Lummer. Translated by Silvanus Thompson. 6s.
- First Book of the Lens.* By C. Welborne Piper. 2s. 6d.
- Lens Facts You Should Know* (No. 140 of "The Photo-Miniature.")
- Telephotography.* By T. R. Dallmeyer. 21s.
- Modern Telephotography.* By Captain Owen Wheeler. 1s. 6d.
- Practical Telephotography.* (No. 90 of "The Photo-Miniature.")
- Lens-work for Amateurs.* By Henry Orford. 3s.
- Tables of Conjugate Foci.* By J. R. Gotz. 6d.
- *Chemistry for Photographers.* By Charles F. Townsend, F.C.S. 1s.
- The Chemistry of Photography.* By R. Meldola. 6s.
- Investigations on the Photographic Processes.* By S. E. Sheppard, D.Sc., and C. E. Kenneth Mees, D.Sc. 6s. 6d.

ART, PORTRAITURE, HAND-CAMERA WORK, ETC.

- Appeal of the Picture.* By F. C. Tilney. 6s.
- Posing the Figure.* (No. 136 of "The Photo-Miniature.")
- Lighting in Portraiture.* (No. 137 of "The Photo-Miniature.")
- Picture-making by Photography.* By H. P. Robinson. 2s. 6d.
- Photography on Tour.* 6d.
- Correct Exposure.* (No. 105 of "The Photo-Miniature.")
- Practical Landscape Photography.* By G. T. Harris. 1s.
- The Portrait Studio.* By "Practicus," of the "B. J." 6d.
- The Photographic Studio.* A guide to its construction, etc. By T. Bolas. 2s.
- Lighting in Photographic Studios.* By P. C. Duchochois. Revised, with additional matter, by W. Ethelbert Henry, C.E. 1s.
- The Studio, and what to do in it.* By H. P. Robinson. 2s. 6d.
- Practical Professional Photography.* Vols. I and II. By C. H. Hewitt. 1s. per vol.
- Magnesium Light Photography.* By F. J. Mortimer. 1s.
- Hand-Cameras.* By R. Child Bayley. 1s. 6d.
- Hand-Camera Work.* (No. 107 of "The Photo-Miniature.")
- Reflex Cameras.* (No. 151 of "The Photo-Miniature.")
- Photography of Moving Objects and Hand-camera Work for Advanced Workers.* By Adolphe Abrahams. 1s.
- Instantaneous Photography.* By Sir William Abney. 1s.
- Copying Methods.* (No. 41 of "The Photo-Miniature.")
- Panoramic Photography.* (No. 73 of "The Photo-Miniature.")
- Stereoscope and Stereoscopic Photography.* From the French of F. Drouin. 2s.
- Stereoscopic Photography.* (No. 98 of "The Photo-Miniature.")
- Photo-micrography.* By E. J. Spitta. 12s.

Handbook of Photo-micrograph By H. Lloyd Hind and W. Brough Randles. 7s. 6d.

NEGATIVE PROCESSES.

- Wet-collodion Photography.* By Charles W. Gamble. 1s.
The Wet Collodion Process. By Arthur Payne. 3s.
Collodion Emulsion. By H. O. Klein. 5s.
Practical Orthochromatic Photography. By Arthur Payne. 1s.
The Photography of Coloured Objects. By C. E. Kenneth Mees. D.Sc. 1s.
Modern Methods of Development. (No. 139 of "The Photo-Miniature.")
Negative-making. By Sir William Abney, F.R.S. 1s.
The Watkins Manual (of exposure and development). By Alfred Watkins. 1s.
Photography by Rule. By J. Sterry. 1s.
Finishing the Negative. Edited by H. Snowden Ward. 1s.
Remedies for Defective Negatives. (No. 143 of "The Photo-Miniature.")
Art of Retouching Negatives, and Finishing and Colouring Photographs. By T. S. Bruce and Alfred Braithwaite. 2s. 6d.

PRINTING PROCESSES.

- Photographic and Photo-mechanical Printing Processes.* By W. K. Burton. 4s.
Art and Practice of Silver Printing. By Sir William Abney and H. P. Robinson. 2s. 6d.
Toning Bromide Prints. By R. Blake Smith. 1s.
Toning Bromides. By C. W. Somerville. 1s.
Toning Bromide and Gaslight Prints. (No. 103 of "The Photo-Miniature.")
Photographic Enlarging. By R. Child Bayley. 1s. 6d.
Enlarging on Development (Gaslight) and Bromide Papers (No. 144 of "The Photo-Miniature.")
Photographic Enlargements: How to Make Them. By Geo. Wheeler. 1s.
ABC Guide to Autotype Permanent Photography. By J. R. Sawyer. 1s.
Carbon Printing. By E. J. Wall. 1s.
Ozobrome, Science and Practice. By Thomas Manly. 1s.
Photo-aquatint, or Gum Bichromate Process. By Alfred Maskell and R. Demachy. 1s.
Oil and Bromoil Printing. (No. 106 of "The Photo-Miniature.")
Platinotype Printing. By A. Horsley Hinton. 1s.
Photographic Reproduction Processes. By P. O. Duchochois. A treatise on photographic impressions without silver salts. 2s. 6d.
Photographic Enamels By René d'Helicourt. 2s. 6d.
Trimming, Mounting, and Framing. (No. 102 of "The Photo-Miniature.")

LANTERNS AND LANTERN SLIDES: CINEMATOGRAPH.

Modern Magic Lanterns. By R. Child Bayley. 1s.

The Lantern, and How to Use It. By Goodwin Norton. 1s.

Optical Projection. By Lewis Wright. 6s.

The Optical Lantern: for Instruction and Amusement. By Andrew Fringle. 2s. 6d.

Practical Slide-making. By G. T. Harris. 1s. 6.

How to Make Lantern Slides. (No. 130 of "The Photo-Miniature.")

Living Pictures. By H. V. Hopwood. 2s. 6d.

Animated Photography. By Cecil M. Hepworth. 1s.

The Handbook of Kinematography. By Colin N. Bennett. 5s.

The Modern Bioscope Operator. 3s. 6d.

PHOTO-MECHANICAL PROCESSES, ETC.

Horgan's Half-tone and Photo-mechanical Processes. By S. H. Horgan. 12s. 6d.

Half-tone Process, The. By Julius Verfassser. 5s.

Half-tone Process on the American Basis. By Wm. Cronenberg. 2s.

A Treatise on Photogravure in Intaglio. By the Talbot Klic process. By Herbert Denison. 4s. 6d.

Photo-Mechanical Processes. By W. T. Wilkinson. 4s.

X-rays Simply Explained. By R. P. Howgrave Graham. 6d.

COLOUR PHOTOGRAPHY.

Photography in Colours. By Dr. Lindsay Johnson. 3s. 6d.

Photography in Colours. By Bolas, Tallent and Senior. 1s. 6d.

Three-colour Photography. By Baron von Hübl. Translated by H. O. Klein. 7s. 6d.

Natural-colour Photography. By Dr. E. König. Translated by E. J. Wall. 2s.

All about Colour Photography. (No. 128 of "The Photo-Miniature.")

Colour Photography Instructions. (No. 147 of "The Photo-Miniature.")

COPYRIGHT IN PHOTOGRAPHS.

The law of the reproduction of photographs is now governed by the Copyright Act, 1911, which came into force in Great Britain and in some minor British Protectorates on July 1, 1912.

The Copyright (Works of Art) Act, 1862, given in previous editions of the "Almanac," is repealed with the exception of Sections 7 and 8.

The new Act provides protection for all classes of work, both literary and artistic, and is, therefore, a lengthy one, but the chief provisions as to photographs are given below. For a full and adequate, yet simple, treatment of the subject, as far as possible in

non-legal language, the reader is referred to "Photographic Copyright," written by the Editor of this Almanac in conjunction with Alexander Mackie, hon. secretary of the Professional Photographers' Association, and published by Messrs. H. Greenwood and Co., Ltd., 24, Wellington Street, Strand, London, W.C., price 1s. net: post free, inland and abroad, 1s. 1d.

Copyright in a photograph lasts for fifty years from the making of the negative. Registration of copyright is abolished.

The copyright belongs to the author unless first made "to the order" of some other person for a valuable consideration, in which case it belongs to the person giving the order.

All assignments of copyright must be in writing.

Photographers can obtain civil remedies (damages, injunctions, etc.) for infringement of copyright; or, where infringement is shown to have been done knowingly, summary remedies (fines and imprisonment) against the infringer.

Infringing copies may be prevented from importation into the United Kingdom by notice to the Customs' Commissioners.

Existing copyright photographs (made before July 1, 1912) obtain the full protection of copyright granted by the 1911 Act. They obtain this whether registered or not under the old Act.

The Act provides for copyright in cinematograph films, and permits photographs to be taken of copyright architectural works of art (buildings); and also of sculpture which is situated in a public place. Such photographing is not an infringement of the copyright in the architecture or sculpture.

In accordance with certain unrepealed clauses of the Copyright Act of 1852 it is an offence against the photographer for his work to be fraudulently issued with a false name or marking, or to be exhibited or sold falsely marked. Copies of photographs may not be issued as having been made by the original author, and a photograph in which unauthorised alterations have been made must not be issued as the unaltered work of the author.

REPRODUCTION FEES.

The Copyright Union has drawn attention to the following suggestions, drawn up for the guidance of its members, by Mr. Alfred Ellis:—

Members are advised not to give permission for their copyright photographs to be reproduced until they have full particulars of the size and style of the proposed reproduction, when they can formulate their charges accordingly. For example: a newspaper should pay a fee of not less than 10s. 6d. for half-tone black-and-white reproduction not exceeding 6 by 4 ins., when printed with letterpress in one issue of a newspaper; but if it is to be printed as an inset the fee should be at least one guinea. If printed in colours, colotype, or photogravure, it should be a still higher fee. If a photograph is to be reproduced for advertising purposes a higher fee should be charged than for newspaper work. In all cases the permission must be in writing, and should state the fee to be paid, the process by which the photograph is to be reproduced and whether in black-and-white or colours, the size limit, and the purpose for which the reproduction may be used.

Makers of Photo-Materials and Booklets issued free by them.

In this list are included in addition to the names of actual makers, those also of some few sole or special agents, supplying goods under manufacturers' labels. The list does not attempt to include firms supplying unbranded photographic materials.

Plates (other than P.O.P., Bromide and Self-Toning Papers. Lantern) and Films Gaslight Papers

Austin Edwards
Cadett
Carter
Collie
Criterion
Elliott
Gem
Grant
Ilford
Imperial
Kodak
Leto
Marion
Mawson
Paget
Rajar
Wellington
Wratten

Anseo
Baryta
Cadett
Criterion
Elliott
Gem
Griffin
Grant
Ilford
Illingworth
Imperial
Kentmere
Kodak
Kosmos
Leto
Marion
Paget
Rajar
Takiris
Wellington

Criterion
Elliott
Griffin
Ilford
Illingworth
Imperial
Kentmere
Kodak
Leto
Paget
Rajar
Wellington

Platinum Papers

Platinotype Co.

Lantern Plates

Cadett
Elliott
Gem
Grant
Griffin
Ilford
Imperial
Kodak
Leto
Marion
Mawson
Paget
Thomas
Wellington
Wratten

Collodio Chloride Paper

Grant
Ilford
Kodak
Leto
Marion
Paget
Rajar

Carbon

Autotype Co.
Elliott
Illingworth
Kentmere

Miscellaneous Print- ing Papers

Halden
Marion
Paget

BOOKLETS, ETC., ISSUED GRATUITOUSLY BY THE PHOTOGRAPHIC
TRADE.

ADHESIVE DRY-MOUNTING CO. LTD.—All about Dry-mounting.

ALDIS BROS.—Child Portraiture.

ANSCO, LTD.—Professional Cyko Manual.

" " Cyko (gaslight) Printing for Amateurs.

AUTOTYPE CO.—First steps in Autotype Printing.

BURROUGHS WELLCOME & CO.—Warm Tones on Gaslight Papers.

" " " " Time Development.

CRITERION, LTD.—The Plate Photographie.

ELLIOTT & SONS, LTD.—Aids to Exposure, Development and Printing.

" " " Printing and Enlarging by Carbon Process.

" " " X-ray Photography.

GRANT, THOS. K.—Instructions for use of Autochrome Plates,
Lumière Plates, Films, Papers, and Chemicals.

ILFORD LTD.—Ilford Plates. (Exposure, Developing, Intensification,
etc.)

" " Every-Day Book of Common Failures Illustrated.

" " Ilford Exposure Tables.

" " Notes on Isochromatism.

" " Printing on P.O.P. and Self-Toning Paper.

" " Bromide and Gaslight Papers.

" " Lantern Slides on Dry Plates.

" " Ilford X-Ray Plates.

" " Dry Plates for Process Work.

ILLINGWORTH & CO., LTD.—Guide to Photographic Printing (all
Processes).

IMPERIAL DRY PLATE CO., LTD.—Imperial Handbook.

" " " " Faults in Negatives.

" " " " Orthochromatic Photography.

" " " " The use of Imperial P.O.P.

" " " " Imperial Process Plates.

JOHNSON MATTHEY & CO., LTD.—Economy in Toning.

JOHNSON & SONS.—Correct Development.

KODAK, LTD.—The Velox Book.

" " Portrait Attachment.

KOSMOS PHOTOGRAPHICS, LTD.—Kosmos Papers.

LETO PHOTO MATERIALS CO., LTD.—Lantern-Slide Making.

" " " " Perfect Prints (on Self-Toning
Paper).

" " " " The Perfect Negative.

" " " " Photography Boardoid.

MARION & CO., LTD.—Marion's Plates and Papers.

" " Northlight Lamp.

MAWSON & SWAN, LTD.—Orthochromatic Photography.

" " " Lantern-Slide Making.

PAGET PRIZE PLATE CO., LTD.—Paget Prize Plates and How to Use Them.

" " " " Paget Panchromatic Plates.

" " " " Paget P.O.P. and How to Use it.

" " " " Exposure Tables for Paget Plates.

" " " " Paget Self-Toning Papers.

" " " " Paget Colour Photography.

PLATINOTYPE CO.—Instructions for Platinotype Printing.

" " " Satista Paper.

RAJAR, LTD.—Working Roll Films.

VANGUARD CO.—Varnishing Negatives.

" " " Backgrounds in Negatives.

" " " Firelight Portraits.

" " " Intensification and Reduction.

WELLINGTON & WARD.—Wellington Photographic Handbook (120

" " " Wellington Plates.

" " " Wellington Roll Films.

" " " Wellington P.O.P.

" " " Bromide Printing.

" " " Wellington Anti-Screen Plate.

" " " Wellington S.O.P. (gaslight paper).

" " " Wellington B.B. Paper.

" " " Lantern-Slide Making.

" " " Wellington X-ray Plates.

WRATTEN DIVISION—KODAK, LTD.—Photographic Dry-Plates, Filters and Screens.

" " " .Real Orthochromatism.

" " " Wratten Panchromatic Plates.

" " " Lantern Slides.

TABLES.

WEIGHTS AND MEASURES.

The formulæ in the editorial pages of this ALMANAC are given, in almost all cases, in both British and metric measures, and in adopting this course we have had the desire to impress upon photographers the simplicity and facility of the latter system. As a rule, the British formulæ are expressed in grains or ounces per 20 ozs. of solution, and the metric formulæ in grammes per 1000 c.c.s. In regard to the total bulk of solution, our formulæ are mostly drawn up on the basis that the total bulk after the solution of the solids is that stated in the formula—20 ozs. or 1000 c.c.s. as a rule.

The question of a 10 per cent. solution is a point in formulæ making and using which has caused endless discussion; but it is really simple enough if it be borne in mind that the ounce avoirdupois contains $437\frac{1}{2}$ grains, while the fluid ounce contains 480 minims. As 10 per cent. solutions, being strong, are usually measured out in minims, the ounce avoirdupois must be dissolved in enough water to make a solution containing 1 grain in 10 minims; that is to say, 4375 minims, or practically 9 ounces, is the proper bulk for the solution of 1 ounce avoirdupois. But if a solution is to be measured out in fluid ounces, then the 10 per cent. solution will be 1 oz. in 10 fluid ozs.

Throughout this work "grains per ounce" are converted into "grammes per litre" by multiplying by 2.3. Ounces per any given number of fluid ounces are converted by taking the same ratio of grammes to 1000 c.c.s.

In reference to the names of chemicals, "sodium carbonate" and "sodium sulphite" are used for the crystallised forms of these substances. If the "dry" ("anhydrous") forms are meant, one or other of these terms is used in qualification.

FLUID MEASURE.

1 Cubic centimetre* (c.c.) (1/1000th litre) = 16.9 minims

1 Litre (1 L.) = 35 ozs. 94 m. = 16894.1 minims

Conversion of Metric into British Measures.

GMS. PER LITRE INTO GRAINS PER 10* OZS.

The following table gives the most convenient means of translating metric formulæ into British measures.

* The figures given in Columns 2, 4, and 6 are a correct translation of the metric proportion when the solution is measured out in ounces and fractions of an ounce. If to be measured in minims, the quantities in Columns 2, 4, and 6 are dissolved in 9 ozs. 2 drs. of water.

1	2	3	4	5	6		
Gms. Per Litre.	Grs. Per 10† ozs.	Gms. Per Litre.	Grs. Ozs. Grs. Per 10† ozs.	Gms. Per Litre.	Grs. Ozs. Grs. Per 10† ozs.		
1	4.4	30	131	1—22	155	678	1—22
2	8.8	35	153	1—44	160	700	1—44
3	13.1	40	175	1—66	165	722	1—66
4	17.5	45	197	1—88	170	744	1—88
5	21.9	50	219	1—0	175	766	1—0
6	26.2	55	241	1—22	180	788	1—22
7	30.6	60	262	1—43	185	809	1—43
8	35.0	65	284	1—65	190	831	1—65
9	39.4	70	306	1—87	195	853	1—87
10	43.8	75	328	1—0	200	875	2
11	48.1	80	350	1—22	225	984	2—22
12	52.5	85	371	1—43	250	1,094	2—43
13	56.9	90	393	1—65	275	1,203	2—65
14	61.2	95	415	1—87	300	1,313	3
15	65.6	100	437	1—0	325	1,422	3—22
16	70.0	105	459	1—22	350	1,531	3—43
17	74.4	110	481	1—44	375	1,641	3—66
18	78.8	115	503	1—66	400	1,750	4
19	83.1	120	525	1—88	425	1,859	4—22
20	87.5	125	547	1—0	450	1,969	4—43
21	91.9	130	569	1—22	475	2,078	4—66
22	96.2	135	591	1—44	500	2,187	5
23	100.6	140	613	1—66	† N.B.—Quantities in Columns 2, 4, and 6 are dissolved in 9 ozs. 2 drs. when solutions are to be measured out in minims.		
24	105.0	145	634	1—87			
25	109.4	150	656	1—0			

* Millilitre and C.C.—Revisions of metric standards have shown that the litre is from official

circles to retain the pronunciation of the term "cubic centimetre," and the employment of "millilitre" for the true thousandth part; millilitre to be abbreviated to "mil." On grounds of terminology there is some reason for this, but until "millilitre" commences to oust c.c. from current writings we shall continue to use the latter term. As regards error, the difference is absolutely negligible, not more than 4 drops in 35 ozs.

GRAMMES INTO GRAINS AND OUNCES (AVOIRDUPOIS).

Gms.	Ozs.	Grs.	Gms.	Ozs.	Grs.	Gms.	Ozs.	Grs.
0.1		1.5	16		28.1	130	4½	37
0.2		3.1	17		43.5	140	4½	82
0.3		4.6	18		59.0	150	5½	18
0.4		6.2	19		74.4	160	5½	61
0.5		7.7	20		89.8	170	6	0
0.6		9.1	25		57.0	175	6	76
0.7		10.8	30	1	25	180	6½	44
0.8		12.4	35	1	103	190	6½	88
0.9		13.9	40	1½	71	200	7	24
1		15.4	45	1½	38	250	8½	32
2		30.9	50	1½	6	300	10½	31
3		46.3	55	1½	83	350	12½	41
4		61.7	60	2	51	400	14	50
5		77.2	65	2½	19	450	15½	52
6		92.6	70	2½	94	500	17½	61
7		108.0	75	2½	64	550	19½	66
8	½	14.1	80	2½	32	600	21	70
9	½	29.5	85	3	0	650	22½	72
10	½	44.9	90	3	76	700	24½	81
11	½	60.4	95	3½	44	750	26½	91
12	½	75.8	100	3½	11	800	28	95
13	½	91.2	110	3½	56	850	29½	102
14	½	106.7	120	4	102	900	31½	106
15	½	12.7	125	4½	70	1000	35½	11

Note.—In the above table the British equivalents are given in the form most convenient for actual work, viz., in even ounces and quarter ounces, with odd grains over. If calculations need to be made, the following figures giving the equivalents of ounces and quarter-ounces in grains will be found useful:—

½ oz. = 109 grs.	1½ oz. = 765 grs.	3½ ozs. = 1,421 grs.	4½ ozs. = 2,078 grs.
¾ oz. = 219 grs.	2 ozs. = 875 grs.	3¾ ozs. = 1,531 grs.	5½ ozs. = 2,296 grs.
1 oz. = 328 grs.	2½ ozs. = 984 grs.	3¾ ozs. = 1,640 grs.	5¾ ozs. = 2,406 grs.
1 oz. = 437 grs.	2½ ozs. = 1,094 grs.	4 ozs. = 1,750 grs.	6 ozs. = 2,625 grs.
1½ oz. = 546 grs.	2½ ozs. = 1,203 grs.	4½ ozs. = 1,859 grs.	6½ ozs. = 2,734 grs.
1½ oz. = 656 grs.	3 ozs. = 1,312 grs.	4½ ozs. = 1,969 grs.	6¾ ozs. = 2,844 grs.

O.C.S. INTO MINIMS AND OUNCES (FLUID).

O.c.s.	Ozs.	Mins.	O.c.s.	Ozs.	Mins.	O.c.s.	Ozs.	Mins.
1		16.9	6		101.4	11	½	66
2		33.8	7		118.3	12	½	83
3		50.7	8	½	15.2	13	½	100
4		67.6	9	½	32	14	½	117
5		84.5	10	½	49	15	½	13

C.C.S. INTO MINIMS AND OUNCES (FLUID).—*Continued.*

C.c.s.	Ozs.	Mins.	C.c.s.	Ozs.	Mins.	C.c.s.	Ozs.	Mins.
16	$\frac{1}{2}$	30	120	4	107	500	$17\frac{1}{2}$	47
17	$\frac{1}{2}$	47	125	$4\frac{1}{2}$	72	525	$18\frac{1}{2}$	110
18	$\frac{1}{2}$	64	130	$4\frac{1}{2}$	36	550	$19\frac{1}{2}$	52
19	$\frac{1}{2}$	81	140	$4\frac{1}{2}$	85	575	20	114
20	$\frac{1}{2}$	98	150	$5\frac{1}{2}$	14	600	21	56
25	$\frac{1}{2}$	82	160	$5\frac{1}{2}$	63	625	22	0
30	1	27	170	$5\frac{1}{2}$	112	650	$22\frac{3}{4}$	61
35	1	111	175	6	76	675	$23\frac{3}{4}$	4
40	$1\frac{1}{2}$	76	180	$6\frac{1}{2}$	41	700	$24\frac{1}{2}$	66
45	$1\frac{1}{2}$	40	190	$6\frac{1}{2}$	90	725	$25\frac{1}{2}$	8
50	$1\frac{1}{2}$	5	200	7	20	750	$26\frac{1}{2}$	70
55	$1\frac{1}{2}$	89	225	$7\frac{3}{4}$	81	775	$27\frac{1}{2}$	13
60	2	54	250	$8\frac{1}{2}$	24	800	28	75
65	$2\frac{1}{2}$	18	275	$9\frac{1}{2}$	86	825	29	18
70	$2\frac{1}{2}$	103	300	$10\frac{1}{2}$	28	850	$29\frac{3}{4}$	80
75	$2\frac{1}{2}$	67	325	$11\frac{1}{2}$	90	875	$30\frac{3}{4}$	22
80	$2\frac{3}{4}$	32	350	$12\frac{1}{2}$	33	900	$31\frac{1}{2}$	65
85	$2\frac{3}{4}$	116	375	13	95	925	$32\frac{1}{2}$	27
90	3	81	400	14	37	950	$33\frac{1}{2}$	90
95	$3\frac{1}{2}$	45	425	$14\frac{1}{2}$	100	975	$34\frac{1}{2}$	32
100	$3\frac{1}{2}$	10	450	$15\frac{1}{2}$	42	1000	35	94
110	$3\frac{3}{4}$	58	475	$16\frac{1}{2}$	105			

Conversion of British into Metric Measures.

GRAINS INTO GRAMMES.

Grs.	Gms.	Grs.	Gms.	Grs.	Gms.
1	0.065	16	1.037	35	2.268
2	0.13	17	1.102	40	2.592
3	0.194	18	1.166	45	2.916
4	0.259	19	1.232	50	3.240
5	0.324	20	1.296	55	3.564
6	0.389	21	1.361	60	3.888
7	0.454	22	1.426	65	4.212
8	0.518	23	1.490	70	4.536
9	0.583	24	1.555	75	4.860
10	0.648	25	1.620	80	5.184
11	0.713	26	1.685	85	5.508
12	0.775	27	1.750	90	5.832
13	0.842	28	1.814	95	6.156
14	0.907	29	1.880	100	6.480
15	0.972	30	1.944		

OUNCES (AVOIRDUPOIS) TO GRAMMES.

Ozs.	Gms.	Ozs.	Gms.	Ozs.	Gms.
$\frac{1}{2}$	7.09	4	113.40	13	368.54
$\frac{3}{4}$	14.17	5	141.75	14	396.89
$\frac{1}{2}$	21.26	6	170.10	15	425.24
1	28.35	7	198.45	16	453.59
$1\frac{1}{2}$	42.5	8	226.80	17	481.94
2	56.70	9	255.15	18	510.29
$2\frac{1}{2}$	70.87	11	311.8	19	538.64
3	85.05	12	340.19	20	566.99

FLUID OUNCES AND DRACHMS TO C.C.S.

Minims.	C.c.s.	Drs.	C.c.s.	Ozs.	C.c.s.	Ozs.	C.c.s.
5	= .3	$\frac{1}{2}$	1.78	$1\frac{1}{2}$	42.6	11	312.5
10	= .6	1	3.55	2	56.8	12	341.0
15	= .9	2	7.10	3	85.2	13	369.3
20	= 1.2	3	10.65	4	113.6	14	398.0
25	= 1.4	4	14.20	5	142.0	15	426.0
		5	17.75	6	170.5	16	454.5
		6	21.30	7	198.9	17	483.0
		7	24.86	8	227.3	18	511.5
		8	28.41	9	255.7	19	540.0
				10	284.0	20	568.0

CONVERSION RULES.

Grammes per litre into grains per ounce. Multiply the grammes by 0.44.

C.c.s. per litre into minims per ounce.—Divide the c.c.s. by 2 (more exactly, multiply by 0.48).

Grains per ounce into grammes per litre.—Multiply the grains by 2.3. Thus 50 grs. per oz. = 115 grs. per litre.

Minims per ounce into c.c.s. per litre.—Multiply the minims by 2.

COINS AS WEIGHTS.

Silver coinage, it is useful to note, is minted exactly by weight in proportion to its value, viz., 436 $\frac{4}{11}$ grains for every 5s. Thus the threepenny bit is 21·8 grs.; a sixpence, 43·6; shilling, 87·2; florin, 175·4; half-crown, 218 grs.

Thus the sixpence and threepenny piece are almost exactly one-tenth and one-twentieth of the avoirdupois ounce.

Bronze coinage—Three pennies, or five halfpennies, or ten farthings = 1 oz. (avoirdupois).

i.e., the penny = 145·8 grs.; 1 halfpenny, 87·6; and 1 farthing, 43·75 grs.

One sovereign weighs 123·27 grs.; the half-sovereign, 61·63 grs.

$\frac{1}{2}$ oz. (avoir.) = one-halfpenny and one threepenny piece.

$\frac{1}{4}$ " " = two halfpennies and a farthing.

1 " " = three pennies (or five halfpennies).

2 " " = six pennies (or ten halfpennies).

4 " " = twelve pennies (or twenty halfpennies).

FRENCH COINS AS METRIC WEIGHTS.

Lord Crawford's table.

				<i>Silver Coins.</i>			
25 gms...	..			5 francs		10 gms.	..
10 " ..	..			2 "		5 "	..
5 " ..	..			1 "		2 "	..
2 $\frac{1}{2}$ " ..	..			$\frac{1}{2}$ " or 50 centimes		1 "	..
				<i>Bronze Coins.</i>			
						10 centimes	
						5 "	
						2 "	
						1 "	

PARTS.

Formulae given, as many are, in "parts," may be made up by writing gms. for the solid and c.c.s. for the fluid "parts," and converting them into the British measures by any of the tables in this section. Thus: Aduroil, 10 parts; sodium sulphite, 100 parts; water 1000 parts becomes aduroil, 154 grs.; sodium sulphite, 3 ozs. 230 grs.; water, 35 ozs.

INCHES INTO MILLIMETRES.

MILLIMETRES INTO INCHES.

Inches.	Milli- metres.	Inches.	Milli- metres.	Milli- metres.	Inches.	Milli- metres.	Inches.
1	25.4	$\frac{3}{8}$	9.5	0.1	0.0039	13	0.51
$\frac{1}{16}$	23.8	$\frac{1}{8}$	8.7	0.5	0.015	14	0.55
$\frac{1}{8}$	23.0	$\frac{1}{4}$	7.9	1	0.04	15	0.59
$\frac{3}{16}$	22.2	$\frac{3}{8}$	7.1	2	0.08	16	0.63
		$\frac{1}{2}$		3	0.12	17	0.67
$\frac{1}{2}$	20.6	$\frac{1}{2}$	6.4	4	0.16	18	0.71
$\frac{5}{8}$	19.1	$\frac{3}{4}$	5.6	5	0.20	19	0.75
$\frac{3}{4}$	17.5	$\frac{7}{8}$	4.8	6	0.24	20	0.79
		1		7	0.28	21	0.83
$\frac{7}{8}$	15.9	1	3.2	8	0.31	22	0.87
$\frac{15}{16}$	14.3	$\frac{1}{8}$	2.4	9	0.53	23	0.90
$\frac{1}{4}$	12.7	$\frac{1}{4}$	1.6	10	0.39	24	0.94
$\frac{1}{8}$	11.1	$\frac{1}{8}$	0.8	11	0.43	25	0.98
		$\frac{3}{16}$		12	0.47	25.4	1.0

ENGLISH SIZES OF PLATES.

Inches.	Cm.	Inches.	Cm.
$3\frac{1}{4} \times 2\frac{1}{4}$	8.9 × 6.4	7 × 5 ⁴	17.8 × 12.7
$3\frac{1}{4} \times 3\frac{1}{4}$ ¹	8.25 × 8.25	$8\frac{1}{2} \times 6\frac{1}{2}$ ⁵	21.5 × 16.5
$4\frac{1}{4} \times 3\frac{1}{4}$ ²	10.8 × 8.25	10 × 8	25.4 × 20.3
5 × 4	12.7 × 10.1	12 × 10	30.4 × 25.4
$6\frac{1}{4} \times 4\frac{3}{4}$ ³	16.5 × 12.0	15 × 12	38.1 × 30.4

¹ Lantern plate. ² Quarter-plate. ³ Half-plate. ⁴ Usual medium size in America. ⁵ Whole-plate.

CONTINENTAL SIZES OF PLATES IN COMMON USE.

Cm.	Inches.	Cm.	Inches.
4.5 × 6.0*	$1\frac{3}{4} \times 2\frac{3}{8}$	13 × 21	5.12 × 8.25
9 × 12†	3.54 × 4.72	18 × 24	7.08 × 9.44
12 × 16	4.72 × 6.30	24 × 30	9.44 × 11.81
13 × 18‡	5.12 × 7.08	30 × 40	11.81 × 15.75

* Standard size of vest pocket plate camera.

† The standard small size, equivalent to the British quarter-plate.

‡ The standard medium size (British half-plate).

FOREIGN LANTERN SLIDES.

The standard French size for lantern slides is 8 by 8 cm., though many makers prepare slides $3\frac{1}{4}$ by $3\frac{1}{4}$. The American size is 4 by $3\frac{1}{4}$, though some makers use the English quarter-plate ($4\frac{1}{4}$ by $3\frac{1}{4}$).

CHEMICAL TABLES.

TABLE OF SYMBOLS AND EQUIVALENT WEIGHTS OF THE MORE IMPORTANT COMPOUNDS USED IN PHOTOGRAPHY.

The atomic weights of the elements employed in working out the equivalent weights given below are the round numbers contained in the first column of the Table of Atomic Weights on page 529.

NAME.	SYMBOL.	EQUIV. WEIGHT
Acetone	$C_3 H_6 O$	58
„ sulphite	$C_3 H_6 OH SO_3 Na$	162
Acid, acetic	$C_2 H_4 O_2$	60
„ benzoic	$C_6 H_5 COOH$	122
„ boric	$H_3 BO_3$	62
„ carbolic	$C_6 H_5 OH$	94
„ chlorochromic	$Cl Cr O_2 OH$	136
„ chromic (anhydride).	$Cr O_3$	100
„ citric	$C_6 H_8 O_7 H_2 O$	210
„ dithionic	$H_2 S_2 O_6$	162
„ formic	$H_2 CO_2$	46
„ gallic	$C_6 H_2 (OH)_3 COOH, H_2 O$..	188
„ hydrobromic	$H Br$	81
„ hydrochloric	$H Cl$	36.5
„ hydrofluoric	$H F$	34
„ lactic	$CH_3 CH (OH) COOH$	90
„ nitric	HNO_3	63
„ oxalic	$H_2 C_2 O_4$	126
„ pentathionic	$H_2 S_5 O_6$	258
„ perchromic	$H Cr O_4$	117
„ phosphoric	$H_3 PO_4$	98
„ picric	$C_6 H_2 (NO_3)_3 OH$	139
„ pyrogallie	$C_6 H_3 (OH)_3$	126
„ salicylic	$C_6 H_4 (OH) COOH$	138
„ sulphuric	$H_2 SO_4$	98
„ sulphurous	$H_2 SO_3$	82
„ tannic	$C_{14} H_{10} O_9$	322
„ tartaric	$C_4 H_2 (OH)_2 (COOH)_2$	150
„ tetrathionio	$H_2 S_4 O_6$	225
„ trithionio	$H_2 S_3 O_6$	194
Adurol*	$C_9 H_3 (OH)_2 Cl$ (or Br)	—
Alcohol (methyl)	$CH_3 OH$	32
„ (ethyl)	$C_2 H_5 OH$	46

* Adurol is mono-chlor (or mono-brom) hydroquinone.

TABLE OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Alum, ammonia	$\text{Al}_2 (\text{NH}_4)_2 (\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$..	906
„ chrome	$\text{Cr}_2 \text{K}_2 (\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$	998
„ iron ammonia	$\text{Fe}_2 (\text{NH}_4)_2 (\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$..	964
„ potash	$\text{Al}_2 \text{K}_2 (\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$	948
Aluminium chloride	$\text{Al}_2 \text{Cl}_6 \cdot 12\text{H}_2\text{O}$..	267
„ sulphate	$\text{Al}_2 (\text{SO}_4)_3 \cdot 16\text{H}_2\text{O}$	634
„ sulphocyanide	$\text{Al}_2 (\text{CNS})_6$	402
Amidol	$\text{C}_6 \text{H}_3 \text{OH} (\text{NH}_2)_2 \cdot 2\text{HCl}$	197
Ammonia	NH_3	17
Ammonium bichromate	$(\text{NH}_4)_2 \text{Cr}_2 \text{O}_7$	252
„ bromide	$\text{NH}_4 \text{Br}$	98
„ carbonate	$\text{NH}_4 \text{HCO}_3 + \text{NH}_2 \text{COOH} \cdot \text{NH}_4$ —	
„ chloride	$\text{NH}_4 \text{Cl}$	53.5
„ chromate	$(\text{NH}_4)_2 \text{Cr}_2 \text{O}_7$	152
„ citrate	$(\text{NH}_4)_2 \text{C}_6 \text{H}_6 \text{O}_7$	226
„ iodide	$\text{NH}_4 \text{I}$	145
„ molybdate	$(\text{NH}_4)_6 \text{Mo}_7 \text{O}_{24} \cdot 4\text{H}_2\text{O}$	1236
„ nitrate	$\text{NH}_4 \text{NO}_3$	80
„ oxalate	$(\text{NH}_4)_2 \text{C}_2 \text{O}_4 \cdot \text{H}_2\text{O}$	142
„ persulphate	$(\text{NH}_4)_2 \text{S}_2 \text{O}_8$	228
„ phosphate	$(\text{NH}_4)_2 \text{HPO}_4$	132
„ sulphate	$(\text{NH}_4)_2 \text{SO}_4$	132
„ sulphide	$\text{NH}_4 \text{HS}$	51
„ sulphocyanide	$\text{NH}_4 \text{CNS}$	76
„ vanadate	$\text{NH}_4 \text{VO}_3$	117
Amyl, acetate	$\text{C}_7 \text{H}_{14} \text{O}_2$	130
„ alcohol	$(\text{CH}_3)_2 \text{CH} \cdot \text{CH}_2 \cdot \text{CH}_2 \text{OH}$	88
Aniline	$\text{C}_6 \text{H}_5 \text{NH}_2$	93
Antimony, sulphide	$\text{Sb}_2 \text{S}_3$	336
Aurantia	$(\text{C}_6 \text{H}_2 (\text{NO}_2)_3)_2 \text{N} \cdot \text{NH}_4$	456
Aurine	$\text{C} (\text{C}_6 \text{H}_4 \text{OH})_2 \text{C}_6 \text{H}_4 \text{O}$	290
Barium, bromide	$\text{Ba} \text{Br}_2 \cdot 2\text{H}_2\text{O}$	333
„ chloride	$\text{Ba} \text{Cl}_2 \cdot 2\text{H}_2\text{O}$	244
„ iodide	$\text{Ba} \text{I}_2$	391
„ nitrate	$\text{Ba} (\text{NO}_3)_2$	261
„ peroxide	BaO_2	201
„ sulphate	$\text{Ba} \text{SO}_4$	233
Benzole (benzene)	$\text{C}_6 \text{H}_6$	78
Borax (see Sodium borate)		
Bromine	Br	80
Cadmium, bromide	$\text{Cd} \text{Br}_2 \cdot 4\text{H}_2\text{O}$	344
„ chloride	$\text{Cd} \text{Cl}_2$	183
„ iodide	$\text{Cd} \text{I}_2$	366
Calcium, carbide	$\text{Ca} \text{C}_2$	64
„ carbonate	$\text{Ca} \text{CO}_3$	100
„ chloride (cryst.)	$\text{Ca} \text{Cl}_2 \cdot 6\text{H}_2\text{O}$	219

TABLE OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Calcium, chloride (fused)	Ca Cl_2	111
" hypochlorite	Ca (O Cl)_2	153
" sulphate	$\text{Ca SO}_4 \cdot 2\text{H}_2\text{O}$	172
" hydroxide (slaked lime) ..	Ca (OH)_2	74
Carbon, bisulphide	C S_2	76
Celloidin	$\text{C}_{12} \text{H}_{16} \text{O}_6 (\text{NO}_3)_4$	504
Ceric, sulphate	$\text{Ce (SO}_4)_2 \cdot 4\text{H}_2\text{O}$	404
Chloral hydrate	$\text{C Cl}_3 \text{ OH (OH)}_2$	165.5
Chloroform	CH Cl_3	119.5
Chrysoidine	$\text{C}_6 \text{H}_5 \text{N}_2 \text{C}_6 \text{H}_5 (\text{NH}_2)_2$	211.7
Cobalt, chloride	$\text{Co Cl}_2 \cdot 6\text{H}_2\text{O}$	238
Copper, bromide	Cu Br_2	223.5
" chloride	$\text{Cu Cl}_2 \cdot 2\text{H}_2\text{O}$	170.5
" nitrate	$\text{Cu (NO}_3)_2 \cdot 6\text{H}_2\text{O}$	357.5
" sulphate	$\text{Cu SO}_4 \cdot 5\text{H}_2\text{O}$	249.5
Cyanine	$\text{C}_{29} \text{H}_{35} \text{N}_2 \text{I}$	544
Dextrine	$(\text{C}_6 \text{H}_{10} \text{O}_5)_x$	—
Diamidophenol	$\text{C}_6 \text{H}_6 \text{ OH (NH}_2)_2$	124
Eosine	Na or K Salt of	—
	$\text{C}_6 \text{H}_4 (\text{CO})_2 \text{O (C}_6 \text{H}_4 \text{ OH X)}_2$..	—
Erythrosine ,	$\text{C}_6 \text{H}_4 (\text{CO})_2 \text{O (C}_6 \text{H}_4 \text{ OH X)}_2$..	—
	X_2	—
Ether	$\text{C}_4 \text{H}_{10} \text{O}$	74
Ferrous and ferric salts (See Iron)		
Formaline	40 % sol. of CH_2O	—
Glycerine	$\text{C}_3 \text{H}_5 (\text{OH})_3$	92
Glycin†	$\text{C}_6 \text{H}_4 \text{ OH NHCH}_2 \text{ COOH}$..	167
Gold, chloride yellow	$\text{H Au Cl}_4 \cdot 4\text{H}_2\text{O}$	412
" " brown	H Au Cl_4	340
" " potassium	$\text{K Au Cl}_4 \cdot 2\text{H}_2\text{O}$	414
" " sodium	$\text{Na Au Cl}_4 \cdot 2\text{H}_2\text{O}$	398
Hydrogen, peroxide	H_2O_2	34
Hydroquinone	$\text{C}_6 \text{H}_4 (\text{OH})_2$	110
Iodine	I	127
Iridious chloride	Ir Cl_3	299.5
" tetrachloride	Ir Cl_4	335
" potassium "	$\text{K}_3 \text{ Ir Cl}_6$	484
" sodium "	$\text{Na}_2 \text{ Ir Cl}_6$	452
IRON.		
Ferric chloride (dry)	$\text{Fe}_2 \text{ Cl}_6$	325

* The X in these formulæ may be bromine, iodine, or chlorine, which elements in other proportions constitute the various commercial dyes.

† Glycin is γ -oxyphenyl-glycin or γ -oxyphenyl-amido-acetic acid.

TABLE OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Ferric chloride (lump)	$\text{Fe}_2 \text{Cl}_6 \cdot 12\text{H}_2\text{O}$	541
„ ammonia citrate, brown.	$4 \text{ Fe } \text{C}_6 \text{H}_5 \text{O}_7 \cdot 3(\text{NH}_4)_2$	
„ „ green	$\text{C}_6\text{H}_5\text{O}_7 \cdot 3\text{Fe}(\text{OH})_3$	2030
„ oxalate	$5 \text{ Fe } \text{C}_6\text{H}_5\text{O}_7 \cdot 2(\text{NH}_4)_2 \text{C}_8\text{H}_6\text{O}_7$	
„ ammonium oxalate	$\text{NH}_4\text{C}_8\text{H}_6\text{O}_7 \cdot 2\text{H}_2\text{O}$	1956
„ potassium „	$\text{Fe}_2(\text{C}_2\text{O}_4)_3$	376
„ sodium „	$(\text{NH}_4)_2 \text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$	428
Ferrous, chloride (dry)	$\text{K}_2 \text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$	491
„ „ (cryst.)	$\text{Na}_2 \text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 11\text{H}_2\text{O}$	976
„ oxalate	FeCl_2	127
„ potassium oxalate	$\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$	199
„ sulphate	$\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	180
„ ammonia sulphate	$\text{K}_2 \text{Fe}(\text{C}_2\text{O}_4)_3 \cdot \text{H}_2\text{O}$	328
Lead, acetate	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	278
„ nitrate	$\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	392
Lithia, caustic	$\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{H}_2\text{O}$	379
Lithium, bromide	$\text{Pb}(\text{NO}_3)_2$	331
„ carbonate	LiOH	24
Lithium, chloride	LiBr	87
„ iodide	Li_2CO_3	74
Magnesium, chloride	LiCl (cryst. has $2\text{H}_2\text{O}$)	42.5
„ sulphate	LiI	134
Manganese, peroxide	MgCl_2	95
„ sulphate	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	246
Mercury	MnO_2	87
„ bichloride	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$	225
„ iodide	Hg	200
„ potass. iodide (soluble) ..	HgCl_2	271
Metol*	$\text{HgI}_2 \cdot 2\text{KI}$	786
Ortol†	$(\text{C}_6\text{H}_4\text{OH} \cdot \text{NHCH}_3)_2 \cdot \text{H}_2\text{SO}_4$	344
Palladious chloride	$(\text{C}_6\text{H}_4\text{OH} \cdot \text{NHCH}_3)_2 + \text{C}_6\text{H}_4$	
„ potassium chloride	$(\text{OH})_2$	234
Para-amidophenol	PdCl_2	177
Phenol (see Acid carboic)	$\text{K}_2 \text{PdCl}_4$	326
Platinum per (or bi)chloride	$\text{C}_6\text{H}_4 \cdot \text{NH}_2 \cdot \text{OH}$	109
Potassium, ammonium chromate ..	$\text{H}_2 \text{Pt Cl}_6 \cdot 6\text{H}_2\text{O}$	516.4
„ bicarbonate	$\text{K NH}_4 \text{CrO}_4$	173
„ bichromate	$\text{K}_2 \text{HCO}_3$	100
„ boro-tartrate	$\text{K}_2 \text{Cr}_2\text{O}_7$	294
„ bromide	$\text{C}_2\text{H}_2(\text{OH})_2(\text{CO}_2)_2 \cdot \text{BOK}$	214
„ carbonate (dry)	KBr	119
	K_2CO_3	138

* Metol is the sulphate of mono-methyl-para-amido-phenol.

† Ortol is a mixture of one molecule each of methyl-ortho-amido-phenol and hydroquinone.

TABLE OF SYMBOLS. &c. —CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Potassium chlorate	$K Cl O_3$	122.5
„ chloride	$K Cl$	74.5
„ chloro-platinate	$K_3 Pt Cl_4$	413.4
„ chromate	$K_2 Cr O_4$	194
„ citrate	$K_3 C_6 H_5 O_7 H_2 O$	342
„ cyanide	$K C N$	65
„ ferri-cyanide	$K_3 Fe (CN)_6$	329
„ ferrocyanide	$K_4 Fe (CN)_6 3H_2 O$	422
„ hydrate	$K HO$	56
„ iodide	$K I$	166
„ metabisulphite	$K_2 S_2 O_5$	222
„ nitrate.....	$K NO_3$	101
„ nitrite	$K NO_2$	85
„ oxalate.....	$K_2 C_2 O_4 H_2 O$	184
„ percarbonate	$K_3 C_2 O_6$	198
„ perchlorate	$K Cl O_4$	138.5
„ permanganate	$K_2 Mn_2 O_8$	316
„ persulphate.....	$K_2 S_2 O_8$	270
„ sulphate	$K_2 SO_4$	174
„ sulphocyanide	$K C N S$	97
Pyrocatechin	$C_6 H_4 (OH)_2$	110
Rochelle salt	$K Na C_4 H_4 O_6 4H_2 O$	282
Schlippe's salt (sodium sulphant- moniate)	$Na_3 Sb S_4 9H_2 O$	479
Silver, acetate	$Ag C_2 H_3 O_2$	167
„ ammonium nitrate.....	$Ag NO_3 + 2NH_3$	204
„ bromide	$Ag Br$	188
„ carbonate	$Ag_2 CO_3$	276
„ chloride	$Ag Cl$	143.5
„ citrate	$Ag C_6 H_5 O_7$	513
„ fluoride	$Ag F 4H_2 O$	199
„ iodide.....	$Ag I$	235
„ nitrate	$Ag NO_3$	170
„ nitrite	$Ag N$	16
„ oxalate	$Ag_2 C_2$	30
„ oxide	$Ag_2 O$	22
„ phosphate	$Ag_3 P$	41
„ sulphate.....	$Ag_2 S$	31
„ sulphide	$Ag_2 S$	24
„ tartrate	$Ag_2 C_4 H_4 O_6$	36
Sodium, acetate	$Na C_2 H_3 O_2 3H_2 O$	134
„ „ (fused)	$Na C_2 H_3 O_2$	10
„ bicarbonate	$Na H CO_3$	8
„ bichromate	$Na_2 Cr_2 O_7 2H_2 O$	294
„ bi-sulphite	$Na H SO_3$	10

TABLE OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Sodium, borate	$\text{Na}_2 \text{B}_4 \text{O}_7 \cdot 10\text{H}_2\text{O}$	382
„ bromide	$\text{Na Br} \cdot 2\text{H}_2\text{O}$	139
„ carbonate (dry).....	$\text{Na}_2 \text{CO}_3$	106
„ carbonate (cryst.)	$\text{Na}_2 \text{CO}_3 \cdot 10\text{H}_2\text{O} \bullet$	286
„ chloride	Na Cl	58.5
„ chloro-platinate	$\text{Na}_2 \text{Pt Cl}_6 \cdot 6\text{H}_2\text{O}$	560.4
„ citrate.....	$\text{Na}_3 \text{C}_6 \text{H}_5 \text{O}_7 \cdot 5\frac{1}{2}\text{H}_2\text{O}$	357
„ fluoride	Na F	42
„ hydrate (caustic)	Na OH	40
„ hydrosulphite*	Na H SO_3	88
„ hyposulphite†	$\text{Na}_2 \text{S}_2 \text{O}_3 \cdot 5\text{H}_2\text{O}$	248
„ iodide	Na I	150
„ nitrate	Na NO_3	85
„ nitro-prusside	$\text{Na}_4 \text{Fe}_2 (\text{CN})_{10} (\text{NO})_2 \cdot 4\text{H}_2\text{O}$. 600	
„ oxalate	$\text{Na}_2 \text{C}_2 \text{O}_4$	134
„ phosphate	$\text{Na}_3 \text{HPO}_4 \cdot 12\text{H}_2\text{O}$	358
„ tribasic phosphate	$\text{Na}_3 \text{PO}_4 \cdot 12\text{H}_2\text{O}$	380
„ sulphate (cryst.)	$\text{Na}_2 \text{SO}_4 \cdot 10\text{H}_2\text{O}$	322
„ sulphide	$\text{Na}_2 \text{S} \cdot 9\text{H}_2\text{O}$	240
„ sulphite (dry)	$\text{Na}_2 \text{SO}_3$	126
„ „ (cryst.)	$\text{Na}_2 \text{SO}_3 \cdot 7\text{H}_2\text{O}$	252
„ tungstate	$\text{Na}_{10} \text{W}_{12} \text{O}_{41} \cdot 28\text{H}_2\text{O}$	3598
Strontium, bromide	Sr Br_2	247.5
„ chloride (dry)	Sr Cl_2	158.5
„ „ (cryst.)	$\text{Sr Cl}_2 \cdot 2\text{H}_2\text{O}$	194.5
„ iodide	Sr I_2	341.5
„ nitrate	$\text{Sr} (\text{NO}_3)_2$	211.5
Thiocarbamide	$\text{CS} (\text{NH}_2)_2$	76
Thiosinamine	$\text{CS} (\text{NH}_2) \text{NH} \text{C}_2 \text{H}_5$	116
Thymol	$\text{CH}_3 \text{C}_6 \text{H}_3 \text{OH} \text{C}_3 \text{H}_7$	150
Tin (Stannous) chloride.....	$\text{Sn Cl}_2 + 2\text{H}_2\text{O}$	225
Uranium, acetate	$\text{UO}_2 (\text{C}_2 \text{H}_3 \text{O}_2)_2 \cdot 2\text{H}_2\text{O}$	426
„ chloride	$\text{UO}_2 \text{Cl}_2$	343
„ nitrate	$\text{UO}_4 (\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	504
Zinc, sulphate	$\text{Zn SO}_4 \cdot 7\text{H}_2\text{O}$	287

* Called "hyp-sulphite" by chemists.

† Called "thiosulphate" by chemists.

TABLE OF THE SOLUBILITIES OF THE PRINCIPAL SUBSTANCES USED IN PHOTOGRAPHY.

sol.=soluble; v.s.=very soluble; s.s.=slightly soluble; dec.=decomposed;
insol.=insoluble.

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling		
Acetone .....	..	..	..
„ sulphite	v.s.	..	..	s.s.
Acid, acetic				
„ benzoic	380	45	0.27	1 in 2.75 90%
„ borio	29	2.9	34	1 in 28 90%
„ carbolic	15	..	6.6	v.s.
„ chromic (anhydride)	0.6	v.s.	160	sol. with decomp'.
„ citric	3	3	130	
„ formic .....	..	..	..

Acetone.—(Sp. gr. 0.814), boils at 133°F. miscible in all proportions with water, alcohol and ether. 272 gms. dissolve in 100 gms. 20% cane sugar solution at 60°F. A solvent of resin, fats, camphor, pyroxylin and celluloid.

Acetic Acid.—The “glacial” acid, which is that implied in formulæ unless a weaker acid is denoted, solidifies about 50°F. Its sp. gr. is 1.055; it boils at 245°F. It is a solvent of gelatine, celluloid, pyroxyline, fats, oils, etc., blisters the skin, strongly absorbs water from the air, and is miscible with water, alcohol, ether, chloroform and glycerine in all proportions.

Formic Acid.—A colourless liquid of 1.22 sp. gr. (=100% acid), miscible with water and alcohol. Weaker solutions are:—1.20 (90%); 1.18 (80%); 1.15 (65%); 1.12 (50%) and 1.06 (25%).

Hydriodic Acid.—A solution of the gas, HI, and obtainable as strong as sp. gr. 2.0 (=96% HI). Solution of sp. gr. 1.7 contains about 52%; sp. gr. 1.5, about 43%.

Hydrobromic Acid.—A solution of the gas, HBr., in water. The strongest solution has sp. gr. of 1.78 (=82%); sol. of 1.495 sp. gr. contains 48% HBr.; 1.38, 40%; 1.208, 25%.

Hydrochloric Acid.—A solution of the gas, HCl, in water. The commercial strongest acid has sp. gr. 1.16, and contains about 30% HCl. Impure acid is sold as “spirits of salts.”

Hydrocyanic Acid (=Prussic Acid).—The strength of the official acid of the British Pharmacopœia is 2%. A 10% acid is obtainable in the chemical trade. Both are the most deadly and dangerous poisons.

Hydrofluoric Acid is a strongly fuming solution of the gas HF.; it is sold of strengths 40% and 55% HF.

Lactic Acid is sold as a colourless syrupy liquid, miscible with water or alcohol. Sp. gr. 1.21. A weaker acid is also sold commercially containing 50% acid.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling		
Acid, gallic	100	0.3	1	1 in 5 90% alcohol 1 in 40 ether
„ oxalic	9.5	0.3	10½	
„ picric	100	..	1	1 in 10 90%, also in ether
„ pyrogallic.....	2½	v.s.	44	sol. also in ether, not in chloroform
„ salicylic	500	12½	½	1 in 3.5, 1 in 2 in ether
„ tannic	0.5	..	20	1 in 0.6, nearly insol. in ether
„ tartaric.....	¾	½	132	
Alum, ammonia	8.3	0.24	12	insoluble
„ chrome	6	dec.	16	
„ iron ammonia	3	dec.	33	insoluble
„ potash	10	v.s.	96	insoluble
Aluminium, chloride	½	v.s.	400	soluble
„ sulphate	3	1.1	35	
Amidol	4	v.s.	24	less sol. in alc. & eth.
Ammonium, bichromate..	5	½	20	1 in 31 absolute alc.
„ bromide	1.4	v.s.	72	

Nitric Acid.—Strongly corrosive liquid of 1.42 sp. gr. (=71% HNO_3); soluble in water; oxidises alcohol and other organic solvents.

Phosphoric Acid.—Sold as syrupy liquid, that of 1.75 sp. gr. (=about 90% acid) being intended when “phosphoric acid” is prescribed in formulæ.

Sulphuric Acid.—The commercial strong acid is a thick corrosive liquid of 1.84 sp. gr. (=98% H_2SO_4). It absorbs water rapidly from the air, and, mixed with water, great heat is developed. The acid should always be added to water—not *vice versa*.

Sulphurous Acid.—Solution in water of the gas SO_2 ; saturated solution of 1.046 is equivalent to 9.5% H_2SO_3 , but soon loses strength.

Albumen.—On heating the cold solution to 160°F. the albumen separates in insoluble form. Alcohol similarly coagulates albumen.

Methyl Alcohol (sp. gr. 0.814).—The chief constituent of crude wood spirit,” or wood naphtha, in which is usually 10% of acetone.

Ethyl Alcohol forms “absolute alcohol” (sp. gr. 0.830 to 0.834), which contains from 2 to 5% water. Alcohol containing 16% water is “rectified spirit.” “Methylated” spirit consists of rectified spirit plus 10% crude wood spirit and 1% mineral naphtha, the latter precipitating as a milkiness on addition of water. These various forms of alcohol mix with water, which can be abstracted with dry potassium carbonate.

Aluminium Chloride.—100 gms. saturated solution (sp. gr., 1.35) contains 41.1 gms. aluminium chloride.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling.		
Ammonium carbonate ...	4	dec.	25	
„ chloride	3	1.4	35	
„ citrate	$\frac{1}{2}$	v.s.	200	
„ iodide	0.6	v.s.	165	1 in 4 alc., s.s. in ether
„ molybdate ..	$2\frac{1}{2}$	dec.	40	
„ nitrate	$\frac{1}{2}$	v.s.	200	
„ oxalate	23	2.4	4.3	sol.
„ persulphate	$1\frac{1}{2}$	dec.	65	
„ sulphocyanide	0.6	v.s.	160	v.s.
„ vanadate	s.s.	v.s.	..	
Antimony sulphide	insol.	..	..
Aurantia	s.s.	..	..	v.s.; s.s. in ether
Aurine	s.s.	..	..	sol.; also in ether
Barium bromide	0.75	0.5	133	v.s. in benzole
„ chloride	2.4	1.3	42	insol.
„ iodide	$\frac{1}{2}$	v.s.	200	1 in 20 alcohol
„ nitrate	12	3.1	8	insol.
Bromine	31	..	3.2	
Cadmium, bromide	0.94	v.s.	106	1 in 3 alc.; 1 in 250 eth.
„ ammonium bromide	0.7	v.s.	137	
„ chloride	0.71	0.67	140	1 in 8 alcohol
„ iodide	1.08	0.75	93	1 in 1 alc.; 1 in 3-6 eth.
Calcium, chloride (cryst.)	$\frac{1}{2}$	v.s.	400	
„ „ (fused)	1.4	0.65	70	
„ sulphate	380	450	0.3	
„ hydroxide	700	1,300	0.137	
Ceric sulphate	12	200	8.3	
Chloral hydrate	$\frac{1}{2}$	..	400	1 in 1/5 90%, 1 in 50 carbon bisulphide.
Copper bromide		v.s.		
„ chloride	0.83	v.s.	121	v.s.; also in ether.
„ sulphate	$2\frac{1}{2}$	$\frac{1}{2}$	40	
Cyanine		s.s.	..	
Diamidophenol	sol.	..	..

Aluminium Sulphocyanide is purchased as a reddish solution of 1.16 sp. gr.

Ammonium Sulphide is sold as a deep yellow solution containing also polysulphides.

Amyl Acetate.—Liquid of sp. gr. 0.876, miscible with alcohol and ether but not with water. A solvent of fats, oils, resin, pyroxyline and celluloid.

Amyl Alcohol, the chief constituent of fusel oil, is not miscible with water.

Aniline (sp. gr. 1.036) is freely miscible with alcohol or ether, but only very slightly with water. It boils at 356° F. and coagulates albumen.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling.		
Edinol	sol.	nearly insol. in alcohol or ether. insol. in ether.
Eikonogen	25	..	4.2	
Eosine	sol.	..	..
Ether	12	..	8	s.s.
Erythrosine	s.s.	..	..
Gold, chloride	v.s.	v.s.	..	
Hydroquinone	17	..	6	sol. ; also in carbon bisulphide
Iodine	insol.	insol.	..	
IRON				
Ferric chloride (lump) ..	v.s.	v.s.	..	insol
" " (dry)	0.63	v.s.	160	
" ammonium citrate	4	..	25	
(brown) *	..	..	..
(green) †	..	..	..
" ammonium oxalate	2.1	..	0.48	
" potassium "	15	0.85	6.6	
" sodium "	1.69	0.55	60	
Ferrous chloride (dry) ..	2	v.s.	50	
" " (cryst.)	0.68	v.s.	147	
" oxalate	4500	3800	..	1 in 15 alcohol insol. in ether
" sulphate ‡	1.43	0.27	70	
" am. sulphate § ..	3	..	33	
Lead, acetate	1½	0.5	66	
Lead, nitrate	2	0.7	50	v.s.
Lithia, caustic	s.s.	..	..
Lithium, bromide	0.7	0.4	143	
" carbonate	72	138	1.3	
" chloride	1½	0.8	80	
" iodide	0.61	0.2	164	v.s.
Magnesium, chloride (dry)	1.7	1½	60	
" sulphate	1	0.15	100	v.s.
Manganese, sulphate	0.8	1	120	

Ether (called also "sulphuric ether") is very volatile and inflammable. Boils at 95° F., sp. gr. 0.722.

Formaline.—A commercial strong solution (40%) of formic aldehyde, CH_2O .

Gelatine becomes swollen in cold water and dissolves in hot. Dissolves in the cold by oxalic, acetic, hydrochloric, or nitric acid, barium chloride or chloral hydrate. Precipitated from its solution in water by alcohol.

Glycerine.—Miscible with water or alcohol. Sp. gr. 1.265.

Iodine dissolves freely also in carbon bisulphide or potassium iodide solution.

Ferric Oxalate is very soluble, over 20%, it is partially reduced to ferrous oxalate on heating the solution to 212° F.

§ Seven parts of ferrous sulphate correspond to 10 parts ferrous ammonium sulphate. * 21.7 to 22.4% iron. † 14 to 15% iron.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in—parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling		
Mercury, bichloride	16	1·8	6·3	insol. in absolute alc.
" iodide	150	..	0·66	1 in 4 90%
Metal	sol.	..	..
Ortol	sol.	..	..	s.s.; also in ether
Para-amido-phenol hydrochloride	10	..	10	1 in 22
Phenol (see acid carbolico)				
Potassium, bicarbonate ..	4	dec.	25	
" bichromate ..	10	1	10	
" borotartrate ..	1	v.s.	135	
" bromide	1½	1	65	
" carbonate(dry) ..	0·9	0·64	112	1 in 750
" chlorate	17	2	6	insol.
" chloride	3	1·75	33	insol.
" chloroplatinite ..	6	v.s.	17	
" chromate	2	1·2	50	insol.
" citrate	0·6	v.s.	166	insol.
" cyanide	0·8	v.s.	122	v.s.
" ferricyanide ..	2½	1·3	40	1 in 9
" ferrocyanide ..	3·4	2	29	
" hydrate	½	v.s.	200	insol.; insol. in eth.
" iodide	0·7	½	140	sol.
" metabisulphite ..	sol.	dec.	..	1 in 16, 90%
" nitrate	3½	0·4	28	
" nitrite	1	v.s.	100	
" oxalate	3	v.s.	33	insol.
" percarbonate ..	15	dec.	6·5	
" perchlorate ..	100	5	1	
" permanganate ..	16	..	6·25	
" persulphate ..	50	dec.	2	
" sulphocyanide ..	0·46	v.s.	220	insol. in absolute alc.
" acid sulphate ..	2	0·8	50	
Pyrocatechin	1½	v.s.	80	
Rochelle salt	1½	v.s.	66	
Schlippe's salt	3	v.s.	33	
Silver, acetate	100	..	1	
" carbonate	insol.	..	..
" chlorate	5	2	20	
" citrate¹	insol.	..	..
" cyanide	insol.	..	..
" fluoride²	v.s.	v.s.	..	

1. Readily soluble in ammonia and hypo.

2. AgF·4H₂O is almost as soluble as calcium chloride.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in parts of water.		100 parts water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold	Boiling.		
Silver, nitrate	0.44	0 1	227	1 in 26, 90%
„ nitrite	s.s.	..	..
„ sulphate	87	..	1.15	
„ sulphocyanide	insol.	..	..
„ tartrate	insol.	..	..
Sodium, acetate	2.8	v.s.	36	1 in 50, 90%; insol. in
„ bicarbonate	11.3	dec.	8 8	[ether]
„ bichromate	1	0.6	100	
„ bisulphite	v.s.	..	..
„ borate	12½	½	8	
„ bromide	1.1	0.9	90	1 in 15
„ carbonate (dry) ..	6	2.2	16.2	
„ „ (cryst.)	1.56	v.s.	63.2	
„ chloride	3	2½	35	
„ chloroplatinate ..	sol.	..	..
„ citrate	sol.	..	..	s.s.
„ fluoride	25	..	4	
„ hydrate (caustic) ..	v.s.	v.s.	..	
„ hyposulphite ..	0.6	v.s.	170	insol.
„ iodide	0.6	0.4	166	
„ nitrate	1.1	0.6	85	
„ oxalate	35	..	3	
„ phosphate	6.7	1	15	
„ sulphide	v.s.	v.s.	..	
„ sulphite (cryst.) ..	2.2	1	45	
„ „ (dry) ..	4	..	25	
„ tri-basic phosphate	0.5	v.s.	20	
„ tungstate	8 to 12	..	..	insol.
„ (meta) vanadate ..	½	v.s.	200	
Strontium, bromide	1.01	½	100	1 in 30, 90%
„ chloride	1.96	1	51	
„ „ (cryst.)	1.33	0.6	75	
„ iodide	0.56	0.25	18	
„ nitrate	1.41	1	71	
Thiocarbamide	11	v.s.	9	v.s. also in ether
Thiosinamine	17	..	6	1 in 2 90%; also in eth.
Thymol	330	..	0.3	1 in 3.75 90%; also in
Tin (stannous), chloride ..	1½	v.s.	66	[ether].
Uranium, acetate	v.s.	v.s.	..	
„ chloride	v.s.	v.s.	..	
„ nitrate	½	v.s.	200	
Zinc, sulphate	0.62	0.15	161	

PERCENTAGE OF REAL AMMONIA IN SOLUTIONS OF
DIFFERENT DENSITIES AT 14° C. (57° F.)—CARIUS.

Specific Gravity.	Per-centage Ammonia	Specific Gravity.	Per-centage Ammonia	Specific Gravity	Per-centage Ammonia	Specific Gravity.	Per-centage Ammonia
0.8844	36.0	0.9052	27.0	0.9314	18.0	0.9651	9.0
0.8864	35.0	0.9078	26.0	0.9347	17.0	0.9670	8.0
0.8885	34.0	0.9106	25.0	0.9380	16.0	0.9709	7.0
0.8907	33.0	0.9133	24.0	0.9414	15.0	0.9749	6.0
0.8929	32.0	0.9162	23.0	0.9449	14.0	0.9790	5.0
0.8953	31.0	0.9191	22.0	0.9484	13.0	0.9831	4.0
0.8976	30.0	0.9221	21.0	0.9520	12.0	0.9873	3.0
0.9001	29.0	0.9251	20.0	0.9556	11.0	0.9915	2.0
0.9026	28.0	0.9283	19.0	0.9593	10.0	0.9959	1.0

INDICATORS

(*I.e., Colour Tests for Alkalies and Acids*).

	Acid.	Alkaline.	In presence of Carbon Dioxide.
Litmus	Bright red	Blue	Reddish purple
Cochineal	Yellow	Reddish violet	Not affected
Methyl orange ..	Red	Yellow brown	Not affected
Phenol-phthalein	Colourless	Intense red	Useless

REACTION OF SUBSTANCES TO VARIOUS INDICATORS.

Substance.	Litmus.	Methyl Orange.	Phenol-phthalein.
Alum	acid	neutral	acid
Borax	alkaline	alkaline	neutral
Potass. metabisulphite	acid	neutral	acid
Potass. oxalate	neutral	neutral	neutral
Rochelle salt	neutral	neutral	neutral
Silver nitrate	acid	neutral	acid
Sodium bicarbonate	alkaline	alkaline	neutral
Sodium citrate	alkaline	alkaline	neutral
Sodium bisulphite	acid	neutral	acid
Sodium sulphite	alkaline	alkaline	neutral
Sodium phosphate	neutral	alkaline	neutral

THERMOMETRIC RULES.

The following rules for the rapid conversion of degrees in one system into another will be found useful:—

To Convert Centigrade into Fahrenheit:

Degrees Centigrade $\times 9 \div 5 + 32$.

Ex.— $80^{\circ}\text{C.} \times 9 \div 5 = 144 \div 5 = 28.8 + 32 = 100.8^{\circ}\text{F.}$

To Convert Fahrenheit into Centigrade:

(Degrees Fahrenheit $- 32$) $\times 5 \div 9$.

Ex.— $100^{\circ}\text{F.} - 32 = 68 \times 5 \div 9 = 37.8^{\circ}\text{C.}$

To Convert Fahrenheit into Réaumur:

(Degrees Fahrenheit $- 32$) $\div 9 \times 4$.

Ex.— $95^{\circ}\text{F.} - 32 = 63 \div 9 \times 4 = 28^{\circ}\text{R.}$

To Convert Réaumur into Fahrenheit:

Degrees Réaumur $\times 9 \div 4 + 32$.

Ex.— $16^{\circ}\text{R.} \times 9 \div 4 = 36 + 32 = 68^{\circ}\text{F.}$

To Convert Centigrade into Réaumur:

Degrees Centigrade $\times 4 \div 5$.

Ex.— $60^{\circ}\text{C.} \times 4 \div 5 = 48^{\circ}\text{R.}$

To Convert Réaumur into Centigrade

Degrees Réaumur $\times 5 \div 4$.

Ex.— $80^{\circ}\text{R.} \times 5 \div 4 = 100^{\circ}\text{C.}$

COMPARISON OF THERMOMETER SCALES.

EQUIVALENCE OF CENTIGRADE (CELSIUS) AND FAHRENHEIT THERMOMETERS.

Centigrade.	Fahrenheit.	Centigrade.	Fahrenheit.	Centigrade.	Fahrenheit.
0	32.0	35	95.0	70	158.0
1	33.8	36	96.8	71	159.8
2	35.6	37	98.6	72	161.6
3	37.4	38	100.4	73	163.4
4	39.2	39	102.2	74	165.2
5	41.0	40	104.0	75	167.0
6	42.8	41	105.8	76	168.8
7	44.6	42	107.6	77	170.6
8	46.4	43	109.4	78	172.4
9	48.2	44	111.2	79	174.2
10	50.0	45	113.0	80	176.0
11	51.8	46	114.8	81	177.8
12	53.6	47	116.6	82	179.6
13	55.4	48	118.4	83	181.4
14	57.2	49	120.2	84	183.2
15	59.0	50	122.0	85	185.0
16	60.8	51	123.8	86	186.8
17	62.6	52	125.6	87	188.6
18	64.4	53	127.4	88	190.4
19	66.2	54	129.2	89	192.2
20	68.0	55	131.0	90	194.0
21	69.8	56	132.8	91	195.8
22	71.6	57	134.6	92	197.6
23	73.4	58	136.4	93	199.4
24	75.2	59	138.2	94	201.2
25	77.0	60	140.0	95	203.0
26	78.8	61	141.8	96	204.8
27	80.6	62	143.6	97	206.6
28	82.4	63	145.4	98	208.4
29	84.2	64	147.2	99	210.2
30	86.0	65	149.0	100	212.0
31	87.8	66	150.8	105	221.0
32	89.6	67	152.6	110	230.0
33	91.4	68	154.4	115	239.0
34	93.2	69	156.2	120	248.0

A TABLE OF ATOMIC WEIGHTS OF THE CHEMICAL ELEMENTS.

NAME.	Symbol.	Atomic Weight in Round Numbers	Atomic Weight.
Aluminium	Al	27	27.1
Antimony	Sb	120	120.2
Argon	A	40	39.9
Arsenic	As	75	75.0
Barium	Ba	137	137.43
Beryllium	Be = Gl	9.1	9.1
Bismuth	Bi	208	208.0
Boron	B	11	11.00
Bromine	Br	80	79.96
Cadmium	Cd	112	112.4
Cæsium	Cs	133	132.9
Calcium	Ca	40	40.1
Carbon	C	12	12.0
Cerium	Ce	140	140.25
Chlorine	Cl	35.5	35.451
Chromium	Cr	52	52.11
Cobalt	Co	59	59.00
Copper	Cu	63.5	63.60
Erbium	Er	166	166.0
Fluorine	F	19	19.0
Gadolinium	Gd	156	156.01
Gallium	Ga	70	70.0
Germanium	Ge	72.5	72.5
Gold	Au	197	197.2
Helium	He	4	4.0
Hydrogen	H	1	1.008
Indium	In	115	115.0
Iodine	I	127	126.97
Iridium	Ir	193	193.0
Iron	Fe	56	55.9
Lanthanum	La	139	138.9
Lead	Pb	207	206.92
Lithium	Li	7	7.03
Magnesium	Mg	24	24.36
Manganese	Mn	55	55.0
Mercury	Hg	200	200.0

A TABLE OF ATOMIC WEIGHTS—CONTINUED.

NAME.	Symbol.	Atomic Weight in Round Numbers.	Accurate Atomic Weight.
Molybdenum	Mo	96	96.0
Neodymium	Nd	144	143.6
Nickel	Ni	59	58.70
Niobium	Nb = Cb	94	94.0
Nitrogen	N	14	14.04
Osmium	Os	191	191.0
Oxygen (Standard)	O	16	16.0
Palladium	Pd	106	106.5
Phosphorus	P	31	31.0
Platinum	Pt	193.4	194.8
Potassium	K	39	39.15
Praseodymium	Pr	141	140.5
Rhodium	Rh	103	103.0
Rubidium	Rb	85	85.5
Ruthenium	Ru	102	101.7
Samarium	Sm	150	150.3
Scandium	Sc	44	44.1
Selenium	Se	79	79.2
Silicon	Si	28	28.4
Silver	Ag	108	107.93
Sodium	Na	23	23.05
Strontium	Sr	87.5	87.6
Sulphur	S	32	32.06
Tantalum	Ta	183	183.0
Tellurium	Te	128	127.6
Terbium	Tb	160	160.0
Thallium	Tl	204	204.1
Thorium	Th	233	232.5
Thulium	Tu	171	171.0
Tin	Sn	118	119.0
Titanium	Ti	48	48.1
Tungsten	W	184	184.0
Uranium	U	240	238.5
Vanadium	V	51	51.4
Ytterbium	Yb	173	173.0
Yttrium	Yt	89	89.0
Zinc	Zn	65	65.4
Zirconium	Zr	91	90.6

TABLE OF POISONS AND ANTIDOTES. Compiled by J. ELSDEN.

Poisons.	Remarks.	Characteristic Symptoms.	Antidote.
Vegetable Acid. Oxalic Acid, including Potassium Oxalate	1 drachm is the smallest fatal dose known.	Hot burning sensation in throat and stomach; vomiting, cramps, and numbness.	Chalk, whiting, or magnesia suspended in water. Plaster or mortar can be used in emergency.
Caustic Alkalies Ammonia Potash Soda Mercuric Chloride	Vapour of ammonia may cause inflammation of the lungs. 3 grains the smallest known fatal dose.	Swelling of tongue, mouth, and fauces; often followed by stricture of the oesophagus. Acrid, metallic taste, constriction and burning in throat and stomach, followed by nausea and vomiting.	Vinegar and water.
Acetate of Lead	The sub-acetate is still more poisonous		White and yolk of raw eggs with milk. In emergency, flour paste may be used.
Cyanide of Potassium	a. Taken internally, 3 grs. fatal. b. Applied to wounds and abrasures of the skin.	Constriction in the throat and at pit of stomach: crampy pains and stiffness of abdomen; blue line round the gums. Insensibility, slow gasping respiration, dilated pupils, and apnoeic closure of the jaws. Smarting sensation.	Sulphates of soda or magnesia. Emetic of sulphate of zinc.
Bichromate of Potassium	a. Taken internally. b. Applied to slight abrasions of the skin.	Irritant pain in stomach and vomiting. Produces troublesome sores and ulcers. Powerful irritant.	No certain remedy; cold affusion over the head and neck most efficacious. Sulphate of iron should be applied immediately.
Nitrate of Silver	2 drachms have been fatal.		Emetics and magnesia, or chalk.
Nitric Acid	Inhalation of the fumes has also been fatal.	Corrosion of windpipe and violent inflammation.	Common salt to be given immediately, followed by emetics.
Hydrochloric Acid	1 ounce has caused death.		Bicarbonate of soda, or carbonate of magnesia or chalk, plaster of the apartment beaten up in water.
Sulphuric Acid	1 drachm has been fatal.		
Acetic Acid, concentrated, has as powerful an effect as the mineral acids.			
Iodine	Variable in its action; 3 grains have been fatal.		
Ether	When inhaled.	Effects similar to chloroform.	Vomiting should be encouraged and gruel, arrowroot and starch given freely.
Prussic Acid	2 grains sufficient to kill a dog.	Resembles phosphorus poisoning.	Cold affusion and artificial respiration. No certain remedy. Speedy emetic desirable.

Concentrated Mineral Acids.

ORTHOCHROMATIC DATA.

DISTRIBUTION OF THE COLOURS IN THE SPECTRUM.

(ACCORDING TO LISTING.)

		Wave length.			Wave length.
BROWN	Limit	.. 819.8	CYAN BLUE..	Limit	.. 491.9
	Middle	.. 768.6		Middle	.. 473.0
RED..	Limit	.. 723.4	INDIGO ..	Limit	.. 455.5
	Middle	.. 683.2		Middle	.. 439.2
ORANGE	Limit	.. 647.2	VIOLET ..	Limit	.. 424.0
	Middle	.. 614.9		Middle	.. 409.9
YELLOW	Limit	.. 585.6	LAVENDER..	Limit	.. 396.7
	Middle	.. 559.0		Middle	.. 384.3
GREEN	Limit	.. 534.7		Limit	.. 372.6
	Middle	.. 512.4			

WAVE LENGTHS OF BRIGHT LINES OF ELEMENTS USED IN PLOTTING OUT THE SPECTRUM.

(IN TEN-MILLIONTHS OF A MILLIMETRE ANGSTROM UNITS.)

TABLE I.

Name of line.	Colour.	Salts used.	Wave lengths = λ
Lithium	Red	Lithium chloride or nitrate ..	6705
Lithium	Orange	Lithium chloride or nitrate ..	6102
D	Orange	Sodium chloride or bicarbonate ..	5893
"Little b"	Green	Magnesium ribbon ..	5183
Strontium	Blue	Strontium chloride or metal ..	4607
Calcium	Blue	Calcium nitrate or chloride ..	4227
Potassium	Violet	Potassium chloride ..	4080

Table I. has been drawn up so as to enable any one with nothing more than an ordinary Bunsen gas burner to construct a chart, by means of which the position of any Fraunhofer line in the spectrum may be determined with sufficient accuracy for all photographic purposes. The salts should be dissolved in distilled water so as to form a saturated solution, a narrow loop of copper or iron wire should be wound with fibrous asbestos, and this repeatedly heated in the Bunsen and allowed to cool.

TABLE II.

C	Red	Hydrogen tube	..	..	6563
"Little b"	Green	Magnesium rod	..	..	5183
F	Bluish-green	Hydrogen tube	..	..	4861
Magnesium	Blue	Magnesium rod	..	..	4481
G	Blue	Hydrogen tube	..	..	4308
"Little h"	Blue	Hydrogen tube,	..	..	4102

Table II. will give the data, most easily obtained if a small induction coil is used. A small coil, giving a fat $\frac{1}{2}$ or $\frac{3}{4}$ in. spark, and actuated by three bichromate bottles will suffice to show the lines in this table. The hydrogen tube is, of course, of the well-known Plucker or Salet form. The magnesium may be used in twisted spirals of ribbon, but preferably in rod form, and the rods should be filed to comparatively sharp points. The constricted portion of the vacuum tube and the points of the magnesium rod should be placed parallel to and not at right angles to the slit.

EXPOSURE TABLES.

The following table, based on that of Burton, gives a rough idea of the exposures for various subjects and diaphragms under the following conditions:—

1. Best lighting; midday sunshine in May, June, and July.

2. With the most rapid commercial plates. See below for factors applying to other conditions.

f/ No.	Average Subject with objects in Fore-ground. Street Scenes. Outdoor Picture Studies.	Landscapes with Light Foreground, Lake, River, and Beach Scenes.	Sea, Clouds and Sky.	Subjects with Extra Heavy Foreground, e.g., Dark Trees, Doorways, Groups.	Under Trees, Woods, Avenues, Glades, etc.	Portrait in Average Well-lighted Room.
f/4	1/250	1/500	—	1/120	1/20	1/8
f/4.5	1/200	1/400	—	1/100	1/15	1/7
f/5.6	1/130	1/250	—	1/64	1/10	1/4
f/6.3	1/100	1/200	1/1000	1/50	1/8	1/3
f/7	1/80	1/150	1/800	1/40	1/7	2/5
f/8	1/64	1/120	1/600	1/30	1/5	1/2
f/11	1/30	1/60	1/300	1/15	1/2	1
f/16	1/15	1/30	1/150	1/8	1	2
f/22	1/8	1/15	1/80	1/4	2	4
f/32	1/4	1/8	1/40	1/2	4	8
f/45	1/2	1/4	1/20	1	8	16
f/64	1	1/2	1/10	2	16	30

MORNING.									
	12	11	10	9	8	7	6	5	4
January ..	3 $\frac{1}{2}$	4	5	12					
February ..	2	2 $\frac{1}{2}$	3	4	10				
March ..	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{3}{4}$	2	3	6			
April ..	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2	3	6		
May ..	1	1	1	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{2}$	3	6	
June ..	1	1	1	1	1 $\frac{1}{2}$	2	2 $\frac{1}{2}$	5	12
July ..	1	1	1	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{2}$	3	6	
August ..	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2	3	6		
September ..	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{3}{4}$	2	3	6			
October ..	2	2 $\frac{1}{2}$	3	4	10				
November ..	3 $\frac{1}{2}$	4	5	12					
December ..	4 $\frac{1}{2}$	5	6						
	12	1	2	3	4	5	6	7	8

A MENTAL RULE FOR TELEPHOTO EXPOSURES.

(CAPTAIN OWEN WHEELER.)

Assume that the positive is used at $f/16$. With a meter or by any other means find the exposure required in the ordinary way for stop $f/64$, making due allowance for distance and character of subject. Then multiply the time of exposure thus found by the necessary factor given in the following table for various magnifications:—

For 4 magnifications	×	1	For 10 magnifications	×	6		
5	„	×	1½	11	„	×	7
6	„	×	2	12	„	×	8
7	„	×	3	13	„	×	10
8	„	×	4	14	„	×	12
9	„	×	5				

If the tele-positive is stopped to $f/11$ or $f/8$, the exposure on which the method is based must be taken as for $f/45$ or $f/32$, as the case may be.

PINHOLE EXPOSURES. (WATKINS-POWER NUMBERS.*)

W.P. No.	Diameter.		Nearest Needle Size.	Good Working Distance. Inches.
	Inch.	Inch.		
1	0.160	$\frac{1}{16}$	—	—
2	0.080	$\frac{1}{8}$	—	—
3	0.053	$\frac{1}{16}$	1	40
4	0.040	$\frac{1}{25}$	4	20
5	0.032	$\frac{1}{31}$	5	14
6	0.027	$\frac{1}{36}$	7	10
7	0.023	$\frac{1}{43}$	8	8
8	0.020	$\frac{1}{50}$	10	5

Rule for use of W.P. No. in Column 1.—Multiply W.P. No. of aperture by its working distance from plate. Use the result as the $f/\text{No.}$ in calculating exposure by meter, tables or other means. Whatever the calculated result is in seconds or fractions of a second, expose that number of minutes or fractions of a minute. Example.—W.P. 6 at 8 inches—calculate as $f/48$.

* The principle of this system will be understood from a consideration of an example of focal aperture:—A $\frac{1}{4}$ -inch aperture at 9 inches = $f/36$. If every second on the actinometer is to be reckoned a minute, the aperture must be one-sixtieth the area, that is the diameter must be divided by $\sqrt{60}$ or, near enough, by $\sqrt{64} = 8$. Therefore, an aperture of $\frac{1}{4} \div 8 = \frac{1}{32}$ inch diameter = $f/36$ when minutes are given instead of seconds. Therefore, reasoning backwards, a pinhole of $\frac{1}{32}$ -inch diameter is called No. 4 ($32 \div 8$). Similarly one of half the diameter is No. 8, and so on. Mr. Watkins, in order to allow for the exposure in excess of the theoretical which is needed in pinhole photography, calculates minutes as seconds at $\frac{1}{6}$ instead of $\frac{1}{8}$, the area of aperture, and therefore his so-called W.P. (Watkins-Power number) is obtained by dividing the denominator of the fraction which expresses the diameter of the pinhole by 6.3 instead of 8. Thus, in the case of a $\frac{1}{32}$ -diameter hole, $32 \div 6.3 = 6.2$, or, near enough, W.P. No. is 6.

SHUTTER SPEEDS FOR MOVING OBJECTS.

From the "Wellcome Exposure Record and Diary."

The formula and table given below indicate the shutter speeds necessary to secure negatives sufficiently sharp for direct printing. For enlarging it is better to give $\frac{1}{2}$ to $\frac{1}{3}$ these exposures, or to work further from the object. *The figures are no guide to what is the correct exposure for the plate.*

If D = distance of object in feet, F = focal length of lens, S = speed of object in feet per second, and E = exposure for an object moving across the field of view, then

$$E = \frac{D}{100 F \times S}$$

The following table gives in round figures the shutter speeds necessary for various moving objects, using the ordinary quarter plate lens of about 5 in. focus. The column A is for objects moving directly towards the operator, B for objects moving obliquely towards or from the camera, that marked C for objects moving directly across the field of view.

Distance of Object, 25 ft., unless otherwise stated.	A.	B.	C.
Street groups (no rapid motion) ..	1/5 to 1/10		
Pedestrians (two miles per hour) ..	1/20	1/40	1/60
Animals grazing	1/30	1/60	1/90
Pedestrians (three miles per hour)	1/40	1/80	1/120
Pedestrians (four miles per hour) ..	1/60	1/120	1/180
Vehicles (six miles per hour) ..	1/80	1/150	1/250
Vehicles (eight miles per hour) ..	1/160	1/300	1/500
Cyclists and trotting horses ..	1/240	1/500	1/700
Foot races and sports	—	1/600	1/800
Divers	1/300	1/750	1/900
Cycle races, horse galloping ..	1/60	1/120	1/180
Yachts (10 knots per hour) at 50 ft.	1/120	1/240	1/360
Steamers (20 knots per hour) at 50 ft.	1/150	1/300	1/450
Trains (30 miles per hour) at 50 ft.	1/300	1/600	1/900
Trains (60 miles per hour) at 50 ft.			

At 50 ft. the exposure may be double that at 25 ft.

At 100 ft. the exposure may be double that at 50 ft.

OPTICAL CALCULATIONS.

FINDING THE FOCAL LENGTH OF A LENS.

As simple and accurate a method as any is first to focus the lens on an object at an infinite distance (see table on page 541), and to mark the position of any convenient part of the moving lens front on the fixed camera baseboard, then place any object such as a foot rule before the camera, and focus—by moving only (1) camera as a whole and (2) camera front on baseboard, not back of camera—until image on screen is same size as original. The distance through which the camera front has to be moved to secure this is the focal length of the lens, and is indicated by the separation of the mark on the fixed baseboard from that on the lens front in its final (same-size) position.

FOCAL DISTANCES WHEN COPYING ON A REDUCED SCALE.

When reducing an original x times (linear), distance from original to lens is found by *multiplying* focal length of lens by x and adding one focal length.

Example.—Reducing 12 in. to 4 in. (reduction of 3 linear) with 6 in. lens, distance from original to lens is $6 \times 3 + 6 = 24$ in.

Distance from lens to plate is found by *dividing* focal length by x and adding one focal length.

Thus (conditions as above) $6 \div 3 + 6 = 8$ in.

FOCAL DISTANCES WHEN ENLARGING WITH CAMERA OR LANTERN.

When enlarging a negative x times (linear), distance from negative to lens is found by *dividing* focal length of lens by x and adding one focal length.

Example.—4 inches in negative to 16 inches in enlargement, that is x equals 4. With lens of 8 inch focus, distance from lens to negative is $8 \div 4 + 8 = 10$ in.

Distance from lens to sensitive paper or plate is found by *multiplying* focal length of lens by x and adding one focal length.

Thus (conditions as above) $8 \times 4 + 8 = 40$ in.

"CONJUGATES" AND "EXTRA FOCAL" DISTANCES.

The full distances: (1) lens to plate, and (2) lens to original, are called the "conjugate focal lengths."

Imagine a solid bar projecting in front of and behind the lens to a distance in each case equal to the focal length of the lens. The

distances from opposite ends of the imaginary bar to the original and plate respectively are the "extra focal distances" (E.F.D.). They are the conjugates less one focal length.

MENTAL LENS CALCULATIONS.

By using the "extra focal distances" lens calculations become much more readily done in the head, remembering that:—

When copying or enlarging, say, 4 times, the greater "extra focal distance" is four times the focal length of the lens, and the smaller "extra focal distance" one-fourth the focal length of the lens. Similarly for a 5-times reduction or enlargement, the greater E.F.D. is five times the focal length; the smaller, one-fifth the focal length.

By adding one focal length to each of these E.F.D.'s we get the actual distances from plate and original to lens.

STUDIO CALCULATIONS.

(By the E.F.D. Method.)

To calculate what length of studio is necessary for work of a given kind with a given lens, it is convenient to take the height of the average sitter as:—

Full length standing	68 inches
Head and shoulders	30 inches

When making portraits in the sizes of prints in common use, the degrees of reduction are those given in the following table:—

Name and Size of Photograph.	C. de V.	Cabinet.	Boudoir.*	Imperial.†
Height of image on photograph	3	5	7½	9
For full-length portrait, reduction figure is	23	13	9	7½
For head and shoulders portrait, reduction figure is	10	6	4	3 nearly

$$* 8\frac{1}{2} \times 5. \quad \dagger 10 \times 6\frac{1}{2}.$$

These few figures and the E.F.D. rule given above are all that is required for the ordinary studio calculations.

Thus we want to know what descriptions of work can be done, say, in a studio 18 ft. long with a 10 in. lens, that is we want to find the reduction figure possible in these conditions.

In all calculations of studio working space 6 ft. ought to be subtracted from the wall-to-wall length. The sitter will usually be 3 ft. in front of the back wall, and the photographer wants about the same space behind the camera.

Therefore, working space is 12 ft. = 144 in.

Subtracting 2 focal lengths (20 inches), the space for the two E.F.D.'s is 124 ins. As the smaller E.F.D. is only an inch or so (a fraction of the focal length), it is near enough to take this 124 ins. as the front E.F.D. Dividing it by the focal length,

$$124 \div 10 = 12\frac{1}{2},$$

we get the reduction figure, showing that the greatest reduction we can get is not quite enough for full length cabinets.

Similar studio calculations are readily made, bearing in mind that the total wall-to-wall length is parcelled out thus:

E.F.D. towards object (large).

E.F.D. towards image (small).

Two focal lengths.

Space for sitter and operator (6 ft.).

Remember, too, that the object E.F.D. is equal to the focal length \times the reduction figure, whilst the image E.F.D. is the focal length \div the reduction figure, and is, therefore, never more than an inch or two at the most.

SHORTENING AND INCREASING THE FOCAL LENGTH OF A LENS.

The rule (very rough, on account of the impossibility of knowing from which part of a lens-mount to measure) for finding the focal length of an extra lens, to reduce or increase the focal length of a given lens, is:—

Multiply the focal length to be altered by the final focal length desired, and divide the product by the original focal length less the final focal length.

$$\text{That is: } f_2 = \frac{f_1 \times F}{f_1 - F}$$

where f_1 is the original focal length,

F the final focal length required,

and f_2 the focal length of the necessary added lens.

To increase the focal length use a negative lens.

To reduce the focal length use a positive lens.

MAGNIFIERS.

When using a supplementary lens (magnifier) as a means of bringing near objects into focus, the focal length of the supplementary lens must be equal to the distance of the object. This holds good whatever the focal length of the original lens.

TELEPHOTO CALCULATIONS.

F = equivalent focal length of complete lens.

f_1 = equivalent focal length of positive.

f_2 = equivalent focal length of negative.

E = camera extension, from negative lens to ground glass.

M = magnification, that is number of times the image given by the complete lens is larger than that given by positive alone.

Magnification when working at given extension is found by dividing camera extension by focal length of negative lens and adding 1.

$$M = \frac{E}{f_2} + 1.$$

Camera extension, necessary for given magnification—multiply focal length of negative lens by magnification less 1.

$$E = f_2 (M-1)$$

Focal length of complete lens.—Multiply focal length of positive by magnification.

STEREOSCOPIC FACTS AND FIGURES.

To secure correct conditions of convergency each print must be seen under the same angle of view as that at which it was produced, and the two prints must be mounted in accord with the following rules:—

Let P = separation of any pair of corresponding points on prints

N = separation of same points on negatives.

E = separation of eyes (average is 64 mm.).

L = separation of camera lenses.

A non-prismatic stereoscope being used:—

1. If image points represent infinitely distant objects, make $P = E$.

2. If only near objects are shown and an ordinary single plate double lens stereo camera has been used

$$\text{Make } P = E + L - N.$$

3. If a single camera is used for two separate exposures, or if two separate similar cameras are used together, measure N with negatives placed edge to edge and in the same relative positions that they occupied during exposure, and then

$$\text{Make } P = E - N + \text{length of one plate.}$$

If a prismatic stereoscope, fitted with properly centred half lenses is used, add the width of one prism to above values of P .

DIAPHRAGM NUMBERS.

EQUIVALENT $F/$ - AND UNIFORM SYSTEM NUMBERS.

Rel. Exposure Req'd..	1	2	4	8	16	32	64	128
F Nos.	4	5.6	8	11.3	16	22.6	32	45.2
U.S. Nos.	1	2	4	8	16	32	64	128

NOTE.—Most lenses are now marked with the $f/$ numbers, although the U.S. numbers are used on Kodak lenses. Also the actual diameter of the diaphragm aperture in millimetres is marked on Zeiss lenses such as the "Convertible."

APPROXIMATE INFINITY FOR LENSES OF VARIOUS FOCAL LENGTHS.

By C. WELBORNE PIPER, from "The First Book of the Lens."

FOCAL LENGTH, INCHES.	DISTANCE OF FOCUSING-SCREEN BEHIND PRINCIPAL FOCUS.			
	100 in.	200 in.	500 in.	1000 in.
1	3 yds.	7½ yds.	15 yds.	30 yds.
2	11 "	28 "	55 "	110 "
3	25 "	63 "	125 "	250 "
4	45 "	113 "	225 "	450 "
5	70 "	175 "	350 "	700 "
6	100 "	250 "	500 "	1000 "
7	136 "	340 "	680 "	1360 "
8	178 "	½ mile	¾ mile	1 mile
9½	264 "	660 yds.	¾ "	1½ miles
11½	351 "	¾ mile	1 "	2 "
12½	434 "	1085 yds.	1½ miles	2½ "
13½	525 "	¾ mile	1½ "	3 "
16	700 "	1 "	2 "	4 "
17½	875 "	1½ miles	2½ "	5 "
19½	1056 "	1½ "	3 "	6 "
21	1225 "	1¾ "	3½ "	7 "
22½	1406 "	2 "	4 "	8 "
24	1600 "	2½ "	4½ "	9 "
25	1 mile	2½ "	5 "	10 "
28	1½ miles	3½ "	6½ "	13 "
30	1½ "	3½ "	7½ "	15 "
33	1¾ "	4½ "	9 "	18 "
35	2 "	5 "	10 "	20 "

By focussing accurately on distances not less than those given, w ensure that the focussing-screen is within 100, 200, 500, or, 1000 in from the true principal focus.

DISTANCES WHEN ENLARGING AND REDUCING.

Focus of Lens, inches	TIMES OF ENLARGEMENT AND REDUCTION.							
	1	2	3	4	5	6	7	8
	inches	inches	inches	inches	inches	inches	inches	inches
3	6 6	9 4½	12 4	15 3¾	18 3½	21 3½	24 3¾	27 3¾
3½	7 7	10½ 5½	14 4¾	17½ 4¾	21 4½	24½ 4½	28 4	31½ 3⅞
4	8 8	12 6	16 5½	20 5	24 4½	28 4¾	32 4¾	36 4½
4½	9 9	13½ 6¾	18 6	22½ 5¾	27 5½	31½ 5½	36 5½	40½ 5⅞
5	10 10	15 7½	20 6¾	25 6½	30 6	35 5¾	40 5¾	45 5½
5½	11 11	16½ 8½	22 7½	27½ 6¾	33 6¾	38½ 6¾	44 6¾	49½ 6⅞
6	12 12	18 9	24 8	30 7½	36 7½	42 7	48 6¾	54 6¾
7	14 14	21 10½	28 9¾	35 8½	42 8¾	49 8¾	56 8	63 7¾
8	16 16	24 12	32 10¾	40 10	48 9¾	56 9¾	64 9½	72 9
9	18 18	27 13½	36 12	45 11½	54 10½	63 10½	72 10½	81 10½
10	20 20	30 15	40 13½	50 12½	60 12	70 11¾	80 11¾	90 11½
11	22 22	33 16½	44 14¾	55 13¾	66 13½	77 12¾	88 12¾	99 12¾
12	24 24	36 18	48 16	60 15	72 14¾	84 14	96 13¾	108 13¾

The table is used as follows:—Knowing the focal length of the lens to be used and the degree of (linear) enlargement or reduction, look up the figure for enlargement or reduction in the upper horizontal row, and carry the eye down the column below it until it reaches the horizontal line of figures opposite the focal length of lens in the left-hand column.

When *enlarging*, the greater of the two distances where the two lines join is the distance from lens to the sensitive paper or plate. The lesser is the distance from lens to negative, or picture being enlarged direct in camera.

When *reducing*, the distances are *vice-versa*: the greater is the distance from lens to original, the smaller from lens to sensitive plate.

RELATIVE EXPOSURES WHEN ENLARGING (WITHOUT A CONDENSER).

New Times of Enlarge- ment.	Time of enlargement for which exposure is known.											
	1	1½	2	2½	3	3½	4	5	6	8	10	12
1	1	3	2	1½	1¼	1⅓	1¼	1⅓	1¼	1⅓	1¼	1⅓
1½	1½	1	1	1	1	1	1	1	1	1	1	1
2	2½	1½	1	1	1	1	1	1	1	1	1	1
2½	3	2	1½	1	¾	¾	¾	¾	¾	¾	¾	¾
3	4	2½	1¾	1¼	1	1	1	1	1	1	1	1
3½	5	3½	2½	1½	1½	1	1	1	1	1	1	1
4	6	4	3	2	1½	1¼	1	1	1	1	1	1
5	9	6	4	3	2½	1½	1½	1	1	1	1	1
6	12	8	5	4	3	2½	2	1½	1	1	1	1
8	20	13	9	7	5	4	3½	2½	1½	1	1	1
10	30	19	13	10	7	6	5	3½	2½	1½	1	1
12	42	27	19	14	11	8	7	4½	3½	2	1½	1

To use this table find in the top horizontal line the number of times of enlargement for which exposure is known. Under this number the relative time of exposure for different degrees of enlargement will be found opposite the new times of enlargement in first vertical column.

RELATIVE EXPOSURES WHEN COPYING OR REDUCING.

New Scales of Reduc- tion.	Scale of reduction for which exposure is known.											
	1	2	3	½	1	2	4	10	8	10	15	20
1	1	1½	1½	1½	2½	2½	3	3	3	3½	3½	3½
2	2	1	1½	1½	1½	2	2	2½	2½	2½	3	3
3	3	1	1	1½	1½	1½	2	2½	2½	2½	2½	2½
4	4	1	1	1	1½	1½	1½	2	2	2	2	2
5	5	1	1	1	1	1½	1½	1½	1½	1½	1½	1½
6	6	1	1	1	1	1	1	1½	1½	1½	1½	1½
7	7	1	1	1	1	1	1	1	1	1	1	1
8	8	1	1	1	1	1	1	1	1	1	1	1
9	9	1	1	1	1	1	1	1	1	1	1	1
10	10	1	1	1	1	1	1	1	1	1	1	1
15	15	1	1	1	1	1	1	1	1	1	1	1
20	20	1	1	1	1	1	1	1	1	1	1	1
30	30	1	1	1	1	1	1	1	1	1	1	1

To use this table find in the top horizontal line the scale of reduction for which exposure is known. Under this scale the relative time of exposure for different degrees of reduction will be found opposite the new scales of reduction marked in first vertical column.

TABLE OF VIEW-ANGLES.

DIVIDE THE BASE* OF THE PLATE BY THE EQUIVALENT FOCUS OF THE LENS.

If the quotient is	The angle is	If the quotient is	The angle is	If the quotient is	The angle is
	Degrees.		Degrees.		Degrees.
0.282	16	0.748	41	1.3	66
0.3	17	0.768	42	1.32	67
0.317	18	0.788	43	1.36	68
0.335	19	0.808	44	1.375	69
0.353	20	0.828	45	1.4	70
0.37	21	0.849	46	1.427	71
0.389	22	0.87	47	1.45	72
0.407	23	0.89	48	1.48	73
0.425	24	0.911	49	1.5	74
0.443	25	0.933	50	1.53	75
0.462	26	0.954	51	1.56	76
0.48	27	0.975	52	1.59	77
0.5	28	1.0	53	1.62	78
0.517	29	1.02	54	1.649	79
0.536	30	1.041	55	1.678	80
0.555	31	1.063	56	1.7	81
0.573	32	1.086	57	1.739	82
0.592	33	1.108	58	1.769	83
0.611	34	1.132	59	1.8	84
0.631	35	1.155	60	1.833	85
0.65	36	1.178	61	1.865	86
0.67	37	1.2	62	1.898	87
0.689	38	1.225	63	1.931	88
0.708	39	1.25	64	1.965	89
0.728	40	1.274	65	2.0	90

Example. - Given a lens of 13 inches equivalent focus; required the angle included by it on plate $3\frac{1}{2} \times 4\frac{1}{2}$.

Diagonal is 5.3 inches. $5.3 \div 13 = .407$, corresponding with angle of 23° .

* More accurately the diagonal of the plate, inasmuch as the field of the lens is circular, and if the corners of the plate are to be covered the angle embraced by the lens should be sufficient to cover the diagonal of the plate. The maker of a lens, stated to cover up to a given angle, may be asked if that angle is measured on the length or diagonal of a plate.

The lengths of the diagonals of the plates most commonly used are :-

$3\frac{1}{2} \times 3\frac{1}{2}$ diagonal 4.6 inches	$7\frac{1}{2} \times 5$ diagonal 9.0 inches.
$3\frac{1}{2} \times 4\frac{1}{2}$ " 5.3 "	$6\frac{1}{2} \times 8\frac{1}{2}$ " 10.7 "
5×4 " 6.4 "	10×8 " 12.8 "
$4\frac{1}{2} \times 6\frac{1}{2}$ " 8.0 "	12×10 " 15.6 "
7×5 " 8.6 "	15×12 " 19.2 "

**TABLES OF DISTANCES AT AND BEYOND WHICH ALL
OBJECTS ARE IN FOCUS WHEN SHARP FOCUS IS
SECURED ON INFINITY.**

Ratio marked on Stops.

Focal length of Lens in inches.	f/4	f/5.6	f/6	f/7	f/8	f/10	f/11	f/15	f/16	f/20	f/22	f/32	f/44	f/64
	Number of feet after which all is in focus.													

4	33	24	22	19	17	13	12	9	8	7	6	4	3	2
4½	38	27	25	21	19	15	14	10	10	7	7	5	3½	2½
4¾	42	30	28	24	21	17	15	11	11	8½	7½	5½	4	3
5	47	34	31	27	24	19	17	12	12	9½	8½	6	5	3
5½	52	36	35	30	26	21	19	14	13	10½	9½	6½	5½	3½
5¾	57	40	38	33	28	23	21	15	14	11½	10½	7	5½	3½
6	63	45	43	36	31	25	23	17	15	12½	11½	7½	6	4
6½	68	50	46	38	34	27	25	18	17	13½	13	8½	6½	4
6¾	75	54	50	42	38	30	28	20	19	15	14	9	7	4½
7	81	58	54	46	40	32	29	22	20	16	15	10	7½	5
7½	87	62	58	50	44	35	32	23	22	17½	16	11	8	5½
7¾	94	67	63	54	47	38	34	25	24	19	17	12	8½	6
8	101	72	68	58	51	40	37	27	25	20	18	12½	9	6
8½	109	78	73	62	54	44	39	29	27	22	20	13½	10	6½
8¾	117	83	78	64	58	47	42	31	29	24	21	14½	10½	7
9	124	90	83	71	62	50	45	33	31	25	22	15½	11	7½
9½	132	96	88	76	68	52	48	36	32	28	24	16	12	8
9¾	141	100	94	80	71	56	51	37	35	29	25	17½	12½	8½
10	150	104	100	84	76	60	56	40	38	30	27	19	13½	9
10½	156	111	104	89	78	63	57	42	39	32	29	20	14	10
11	168	120	112	96	84	67	61	45	42	34	31	21	15	10½
11½	180	127	116	101	90	71	65	47	45	35	32	22	16	11
11¾	190	133	125	107	95	75	68	50	47	37	34	24	17	12
12	197	141	131	113	99	79	72	52	50	39	36	25	18	12½
12½	208	148	140	120	104	83	75	55	52	42	38	26	19	13

If sharp focus is secured on any of the distances shown, then, with the stop indicated, all objects are in focus from half the distance focussed on up to infinity.

FOCAL LENGTH OF LENSES RECOMMENDED FOR STUDIOS OF VARIOUS LENGTHS.

The following table shows the focus of lens which is suitable for comfortable working in studios of various lengths. In each case it is assumed that 5 ft. of the length will be taken up by camera, operator and background. The figures in column 1 are the full run of the studio, including this 5 ft. In the case of the short studios the focal lengths are about the longest which can be used. In the case of the longer studios somewhat greater focal lengths might be used, but the lenses directed in the table are about the best for general work.

Length of Studio feet	C.D.V. full length Inches	C.D.V. half length and Cabinet full length Inches	C.D.V. new Cabinet half length Inches	Cabinet head and Boudoir full length Inches	Boudoir half length, 1 unit full length Inches	Boudoir head, Panel half length Inches
12	4*	6½*	8½	9*	12*	14*
14	4½*	7½*	9	10*	13*	16
16	5†	8½	10	10½	16	18
18	6	8½	10½	10½	16*	18
20	6	10	10½	12	18*	20
22	7	10½	12	14	22	22
24	8½	12	14	16	24	24
28	8½	13½	16	16	24	24
30	10	13½	16	18	24	24

* Full lengths may be obtained with these focal lengths, but the standpoint is so near to the sitter that good perspective cannot be expected.

